

## 4. NATURE AND EXTENT OF CONTAMINATION

This section discusses the nature and extent of contamination at each of the retained sites for the Baseline Risk Assessment (BRA). Information detailing the release mechanism responsible for the detected contamination, and the source-term estimates for the Baseline Risk Assessment (BRA) are presented. The data used to identify contaminants and calculate source-term concentrations are summarized in Appendix B.

### 4.1 Summaries of Sites Retained on the RI/FS Work Plan

Screening of all WAG 4 sites was performed in the OU 4-13 Work Plan (McCormick 1997) to identify those sites requiring further investigation, and to identify those sites where the carcinogenic risk for the site contaminants is greater than  $1\text{E-}06$  and/or the hazard quotient is greater than one. These sites were retained for inclusion in this BRA. The screening process employed for each positively detected contaminant, a comparison of the maximum detected concentration to the respective background concentration, identification of the six essential nutrients, and a comparison of the maximum detected concentration to the respective risk-based concentration. Using this process, the following sites were retained:

OU 4-02	CFA-13	Dry Well (South of CFA-640)
	CFA-15	Dry Well (CFA-674)
OU 4-05	CFA-04	Pond (CFA-674)
	CFA-17	Fire Department Training Area, bermed
	CFA-47	Fire Station Chemical Disposal
OU 4-06	CFA-06	Lead Shop (outside areas)
	CFA-43	Lead Storage Area
	CFA-44	Spray Paint Booth Drain (CFA-654)
OU 4-07	CFA-07	French Drain E/S (CFA-633)
	CFA-12	French Drains (2) (CFA-690) [south drain only]
OU 4-08	CFA-08	Sewage Plant (CFA-691), Septic Tank (CFA-716), and Drainfield
	CFA-49	Hot Laundry Drain Pipe
OU 4-09	CFA-10	Transformer Yard Oil Spills
	CFA-26	CFA-760 Pump Station Fuel Spill
	CFA-42	Tank Farm Pump Station Spills
	CFA-46	Cafeteria Oil Tank Spill (CFA-721)
OU 4-11	CFA-05	Motor Pond Pool
OU 4-13	CFA-51	Dry Well at North End of CFA-640
	CFA-52	Diesel Fuel UST (CFA-730) at Bldg. CFA-613 Bunkhouse

Contaminant screening was performed in Section 3.4 of the OU 4-13 RI/FS Work Plan at each of the retained sites to identify COPCs. These COPCs were retained for further evaluation in this BRA to

define the nature and extent of contamination at the retained sites. These data used in this BRA are from Track 1 and Track 2 investigations, verification sampling following removal actions, RI/FSs at specific OUs, and characterization data collected during implementation of the Work Plan.

A supplemental contaminant screen is conducted for each retained site as a component of the nature and extent of contamination evaluation. The purpose of the supplemental contaminant screen is to refine the results of the initial contaminant screen presented in the OU 4-13 RI/FS Work Plan and to determine which of the retained sites contain COPCs that require quantitative risk evaluation in the RI/BRA. The supplemental contaminant screen is necessary because removal actions were performed at some of the retained sites after the Work Plan was finalized, therefore additional analytical data is available for those sites. The analytical data used in the supplemental contaminant screen includes OU 4-11 RI/FS data in addition to verification data collected after contaminated soil was removed.

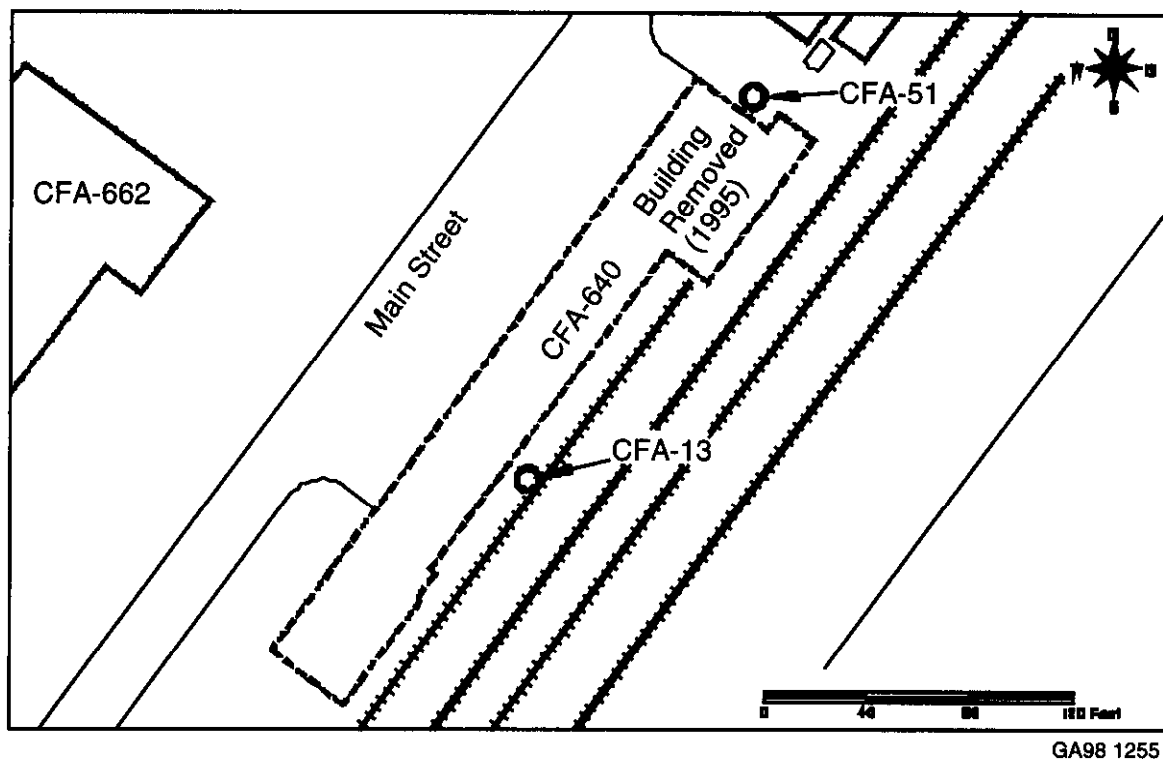
The supplemental contaminant screen is comprised of two screening steps: (1) a comparison of the maximum detected contaminant concentration to the respective background concentration consistent with the Work Plan background values, and (2) a comparison of the maximum detected contaminant concentration to the respective EPA Region III risk-based concentration. If any of the following six (iron, magnesium, calcium, potassium, sodium, and aluminum) was detected, then an essential nutrient screen that involves comparison to ten times the respective background level was used. A contaminant is retained as a COPC if the maximum detected concentration exceeds both screening criteria. Only those contaminants identified as COPCs in the Work Plan are included in the supplemental contaminant screen presented in Appendix C. Results of the screen are discussed in the nature and extent of contamination summaries.

#### **4.1.1 OU 4-02: CFA-13 Dry Well (South of CFA-640)**

**4.1.1.1 Site Summary.** This site consisted of a dry well located south of the demolished locomotive repair shop Building CFA-640, (see Figure 4-1). Building CFA-640 was built in 1950 and provided offices for Security and Power Management, a small area for security physical fitness, a line crew craft area, an automotive repair garage, and a locomotive repair area. The building had a floor drain connected to piping, which ran outside of the building, that was cut and capped. This piping might have run into the CFA-13 dry well; therefore, it is possible that Volatile Organic Compounds (VOCs), Semivolatile Organic Compounds (SVOCs) polychlorinated biphenyl (PCBs), petroleum products, metals, and/or radiological contaminants were discharged to the dry well through this drain (Landis 1998).

**4.1.1.2 Previous Investigations and Removal Actions.** Excavation activities were performed as part of the Track 1 investigation to determine the presence or absence of the dry well. Evidence did not exist at the time of the investigation to indicate that the dry well was ever connected to Building CFA-640 by piping. No record was found pertaining to the dry well's intended use or why it was installed. Personal interviews conducted as part of the Track 1 investigation in July 1995 revealed that the only historical use of the building that may have generated waste products was the locomotive repair area. It was assumed, however, that hazardous substances from this area were not disposed in the dry well because it is located on the opposite side of the building, and oils and greases were reportedly disposed to the waste oil underground storage tanks at Building CFA-665, the large repair shop. In addition, dye tracing tests of the sewer and drain lines indicated that discharge from Building CFA-640 was routed across the tracks to a dry well and may have been tied to a line that runs parallel to Main Street. Consequently, the Track 1 recommendation was "no further action."

Building CFA-640 was demolished in 1995 by the D&D program. Further evidence of the CFA-13 dry well was discovered during demolition, when a floor drain in a former garage area at the north end of the building was discovered. The drain was connected to a buried pipe, which when excavated, ran along



**Figure 4-1.** OU 4-02: CFA-13 Dry Well (South of CFA-640).

the outside south wall of the building. The pipe angled away from the building, where it was cut and sealed. It was believed that this pipe may have been connected to the CFA-13 dry well and that contaminants may have been discharged to the dry well via this drain. Discovery of the buried pipe and floor drain initiated further investigation of the site. The site was retained for further evaluation in the Work Plan (McCormick 1997).

The drywell was excavated during the *WAG 4 Miscellaneous Sites 1997 Non-Time Critical Removal Action*. Soil was excavated to a depth of 1.8 m (6 ft). No dry well was found at this location or within the confines of the demolished CFA-640 building. However, a structure was found that was determined to be a sewer clean out. It was determined that the site thought to be the CFA-13 Dry Well was in fact the found sewer clean-out structure. Therefore, it was decided that the sewer clean-out area would be sampled and the structure removed. After sampling the sewer clean out area, it was backfilled. The sump was thought to exist in the demolished building CFA-640 that may have released contamination to the soil; therefore, excavation continued in an area on the north end of the demolished building in the effort to identify any sump soil contamination. The sump soil contamination was not located during the excavation area sampling; therefore, the area was backfilled. Excavation was again performed on the sewer clean-out area to remove the structure and the approximately 9 m (30 ft) of associated piping. The material was disposed at the CFA Bulky Waste Landfarm. After the final excavation, the removal area was backfilled. The post-removal samples were analyzed for metals, VOCs, SVOCs, and polycyclic aromatic hydrocarbons (PAH). Chromium and 1,1,2-trichloro-1,2,2-trifluoroethane were the only sampled analytes with positively detected concentrations. Sampling results were not available for CFA-13 prior to the October 1997 sampling; therefore, an initial contaminant screen to identify COPCs was not performed in the RI/FS Work Plan. All positively detected chemicals

from the October 1997 sampling were therefore retained for evaluation in the supplemental contaminant screen presented in Appendix C, Tables C-1 through C-3.

The results of the contaminant screen, indicates benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, lead, Am-241, Ra-226, U-235, U-238, and Zr-95 are retained as COPCs for further evaluation in the RI/BRA. Detected concentrations of arsenic are not source related and are assumed to be within the range of background concentrations for INEEL soils. Arsenic is therefore eliminated as a COPC. Benzo(a)anthracene, benzo(b)fluoranthene, and benzo(g,h,i)perylene were all detected in 16.7 percent of 6 samples. Lead was detected in 100 percent of 10 samples. Am-241 was detected in 28.6 percent of 14 samples. Ra-226 was detected in 85.7 percent of 7 samples. U-235 was detected in 64.3 percent of 14 samples. U-238 was detected in 100 percent of 7 samples, and Zr-95 was detected in 14.3 percent of 7 samples. The range of detected concentrations of these COPCs is as follows:

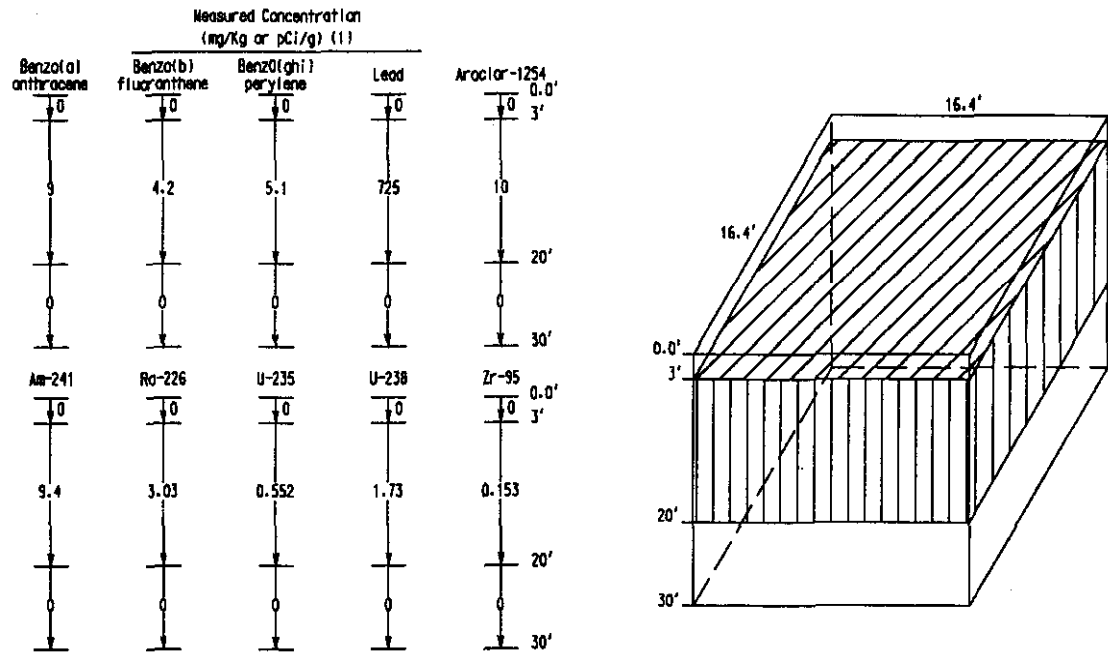
Benzo(a)anthracene	9 mg/kg (only one positive detection is reported)
Benzo(b)fluoranthene	4.2 mg/kg (only one positive detection is reported)
Benzo(g,h,i)perylene	5.1 mg/kg (only one positive detection is reported)
Lead	6.8 to 725 mg/kg
Am-241	0.0207 to 9.397 pCi/g
Ra-226	1.38 to 3.37 pCi/g
U-235	0.0356 to 0.552 pCi/g
U-238	0.753 to 2.53 pCi/g
Zr-95	0.153 pCi/g (only one positive detection is reported)

**4.1.1.3 Nature and Extent of Contamination.** Data from the 1997 removal activities are used in this RI/BRA to characterize the nature and extent of contamination. These data indicate that subsurface soils 0.9 to 6.1 m (3 to 20 ft) bgs at CFA-13 are contaminated with benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, Aroclor-1254, lead, Am-241, Ra-226, U-235, U-238, and Zr-95. The depth of basalt at CFA-13 is unknown; therefore, contamination is assumed to exist in CFA-13 soils from 0.9 to 9.1 m (3 to 30 ft) bgs. This assumption is made to ensure that potential risks from exposures at CFA-13 are not underestimated (Section 6). This assumption is conservative because sample results are not available for depths greater than 6.1 m (20 ft) bgs; however the entire 0 to 9.1m (0 to 30 ft) soil interval is assumed to be contaminated.

The extent of contamination is assumed to encompass the entire site (approximately 25 m<sup>2</sup> [269 ft<sup>2</sup>]). The volume of soil associated with the contamination at CFA-13 is 227.5 m<sup>3</sup> (297 yd<sup>3</sup>) (Figure 4-2). The summary statistics for the CFA-13 COPCs, based on the contaminant screening process, are shown in Tables C-3 and C-4, Appendix C. Figure 4-2 shows the assumptions for the nature and extent of contamination and source-term estimates and exposure point concentrations used to evaluate potential risks associated with the site.

#### **4.1.2 OU 4-02: CFA-15 Dry Well (CFA-674)**

**4.1.2.1 Site Summary.** This site consisted of a dry well 0.6 m (2 ft) in diameter northwest of Building CFA-674, between the building and Nevada Street (see Figure 4-3). No records were found on this site to indicate that waste was sent to this dry well. However, further investigation identified a floor drain inside building CFA-674 with piping connected to the dry well. Therefore, a potential existed that this dry well may have received laboratory liquid waste and solid calcined wastes (Landis et al., 1998).



Legend

Zone of Contamination

Receptors/Pathways and Calculated Exposure Point Concentrations						
Receptor/Pathway	Units	Depth (ft)	Benzo(a)anthracene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Lead
Occ (2) - Air	mg/kg	0 - 0.5 (1)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Occ (2) - External Radiatic	mg/kg	0 - 4 (2)	7.88E+00	3.68E+00	4.46E+00	6.34E+02
Res (3) - All	mg/kg	0 - 10 (2)	3.15E+00	1.47E+00	1.79E+00	2.81E+02
Res (3) - Groundwater	mg/kg	0 - 30 (2)	1.05E+00	4.90E-01	5.95E-01	9.16E+01

Receptors/Pathways and Calculated Exposure Point Concentrations						
Receptor/Pathway	Units	Depth (ft)	Am-241	Ra-226	U-235	U-238
Occ (2) - Air	pCi/g	0 - 0.5 (1)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Occ (2) - External Radiatic	pCi/g	0 - 4 (2)	5.06E-02	2.29E+00	4.83E-01	2.21E+00
Res (3) - All	pCi/g	0 - 10 (2)	3.47E-02	2.94E+00	3.01E-01	1.41E+00
Res (3) - Groundwater	pCi/g	0 - 30 (2)	6.28E+00	1.90E+00	1.46E-01	9.71E-01

#### Assumptions:

The assumed maximum depth of contamination (i.e., 9.1 m [30 ft]) is based on the conservative assumption that the downward mobility of chemicals detected in the vadose zone at CFA-13 is 3.0 m (10 ft). Positive detections of COPCs in the vadose zone are reported no deeper than 6.1 m (20 ft).

#### Notes:

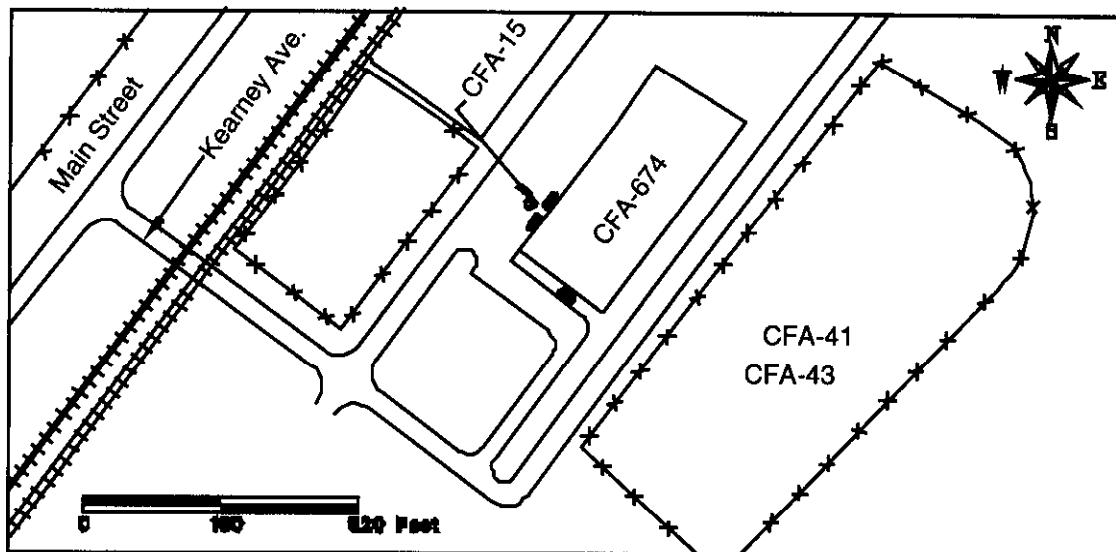
(1) Exposure point concentrations shown for this depth interval represent the 95% lognormal UCL (95 UCL) or maximum detected concentration, whichever is less, for analytical data collected at the site.

(2) Exposure point concentrations (EPC) shown for this depth interval represent volume-weighted concentrations, and are calculated using the following equations:

Depth (ft)	EPC Equation
0-4	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5)]/4$
0-10	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6)]/10$
0-30	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6) + (C_{10-30})(20)]/30$

Where: C = 95 UCL or maximum detected concentration, whichever is less, for the indicated depth interval.

Figure 4-2. OU 4-02: CFA-13 nature and extent assumptions.



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**Figure 4-3.** OU 4-02: CFA-15 Dry Well (CFA-674).

**4.1.2.2 Previous Investigations.** The Track 1 investigation conducted at this site in 1993 revealed that there was no evidence indicating that CFA-15 was connected to the building by piping. No records were found pertaining to the intended use of the CFA-15 dry well or that the dry well had received waste. Radiological screening of surface soils conducted at the site confirmed the presence of radiological activity. The Track 1 Decision Document recommended no further action at CFA-15 (DOE 1995). However, it was noted during preparation of the OU 4-13 Work Plan that the dry well may have received waste from the laboratory in building CFA-674 similar to that discharged to the CFA-04 Pond. Further investigation at this site was therefore warranted.

This dry well was excavated during the *WAG 4 Miscellaneous Sites 1997 Non-Time Critical Removal Action*, during November 1997. Soil was excavated to a depth of 2.4 m (8 ft) in order to remove the dry well. Piping that was connected to the dry well and the west wall of building CFA-674 was cut and dry packed with grout. After removal of the contaminated soil, three samples were collected and analyzed for metals, VOCs, SVOCs, inorganics, herbicides, pesticides, radionuclides, PAHs, and dioxin. All positively detected chemicals were retained for evaluation in the supplemental contaminant screen presented in Table C-4, Appendix C. The results of the supplemental contaminant screen indicate that Ra-226 is retained as a COPC for further evaluation on the BRA. Ra-226 was detected in 100 percent of 6 samples. The range of detected concentrations for Ra-226 was 1.54 to 2.54 pCi/g. The arithmetic mean for these data is 2.00 pCi/g, which is less than naturally occurring background values detected at other INEEL sites (Giles, 1998).

Aluminum, arsenic, barium, chromium, iron, magnesium, manganese, nickel, potassium, thallium, vanadium, zinc, Sr-90, U-234, and U-238 were not retained because maximum detected concentrations of these chemicals did not exceed background values. Aluminum, barium, chromium, copper, fluoranthene, iron, lead, magnesium, manganese, mercury, nickel, pyrene, silver, vanadium, zinc, Am-241, Eu-155, Ru-106, Sr-90, U-234, U-235, U-238 and Zn-65 were not retained because maximum detected concentrations of these chemicals did not exceed risk-based screening concentrations. Calcium and sodium were not retained because maximum detected concentrations of these essential nutrients did not exceed ten times respective background concentrations.

**4.1.2.3 Nature and Extent of Contamination.** Data from the 1997 removal activities are used in this RI/BRA to characterize the nature and extent of contamination. These data indicate that subsurface soils 0.61 to 4.9 m (2 to 16 ft) bgs at CFA-15 are contaminated with low levels of RA-226. It is assumed that the downward mobility of radionuclides suspended in liquids in the vadose zone (i.e., waste water) is approximately 3.0 m (10 ft). The depth of basalt at CFA-15 is unknown; therefore, contamination is assumed to exist at CFA-15 soils from 0.61 to 7.9 m (2 to 26 ft) bgs. This assumption is made to ensure that potential risks from exposure at CFA-15 are not underestimated (Section 6). This assumption is conservative because sample results are not available for depths greater than 4.9 m (16 ft) bgs; however the entire 0 to 7.9 m (0 to 26 ft) soil interval is assumed to be contaminated.

The extent of the contamination is assumed to encompass the entire site (approximately 0.3 m<sup>2</sup> [0.31 yd<sup>2</sup>]). The volume of soil associated with the contamination at CFA-15 is 2.4 m<sup>3</sup> (3.1 yd<sup>3</sup>) (Figure 4-4). The summary statistics for the CFA-15 COPC, based on the contaminant screening process are shown in Tables C-5 and C-6, Appendix C. Figure 4-4 shows the assumptions for the nature and extent of contamination and source-term estimates and exposure point concentrations used to evaluate potential risks associated with the site.

### **4.1.3 OU 4-05: CFA-04 Pond (CFA-674)**

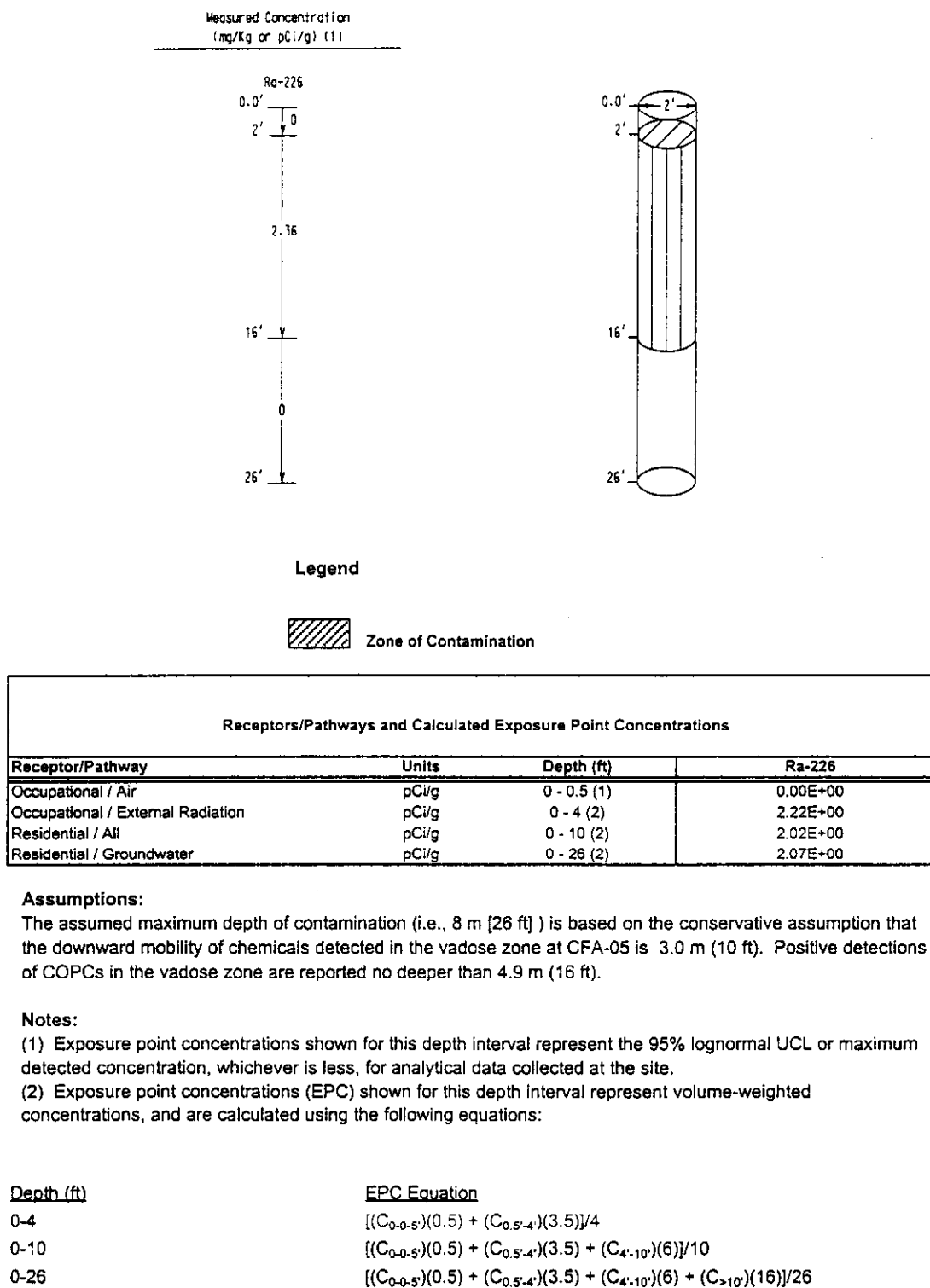
**4.1.3.1 Site Summary.** This site consists of a shallow pond located southeast of the termination of Nevada Street which was formerly used for the disposal of wastes from operations at CFA-674 (see Figure 4-5). CFA-674 contained the Chemical Engineering Laboratory (CEL) which operated from 1953 until 1965 to conduct pilot studies of a nuclear waste calcining process on simulated (no fuel) nuclear fuel rods. Building CFA-674 is now used as a warehouse and also contains a photography laboratory. There are no current discharges from the building to the pond.

Three waste generation processes were identified as sources of contamination from CFA-674 to the pond in the Track 2 Preliminary Scoping Package: (1) from approximately 1953 to 1965, mercury-contaminated wastes from the calcine development work in CFA-674; (2) from approximately 1953 to 1969, liquid laboratory effluent from the CEL; and, (3) dates unknown, bulky waste including asbestos-containing roofing material from construction projects at the INEEL.

Liquid and solid wastes resulting from operations at the CEL may have included simulated calcine, sodium nitrate, nitric acid, tributyl phosphate, uranyl nitrate, a high grade kerosene, aluminum nitrate as well as hydrochloric and chromic acid, di-chromate solutions, terphenyls, heating oil, zirconium, hydrofluoric acid, trichlorethylene and acetone.

High concentrations of mercury were often present in the calcine because it was used as a catalyst in the dissolution of simulated aluminum nuclear fuel cladding. Effluent from scrubbers on the calciners would also have contained mercury, probably in the form of mercuric nitrate. In a small number of the tests conducted, chemical tracers (chromium, copper, iron, and nickel) or radioactive tracers (Cs-137, Sr-90, Ru-106, and uranium isotopes) were used to characterize parameters of interest in the calcine process. Most calcine was disposed to the pond and buried; however, limited quantities were contained in bottles, which were also buried in the pond.

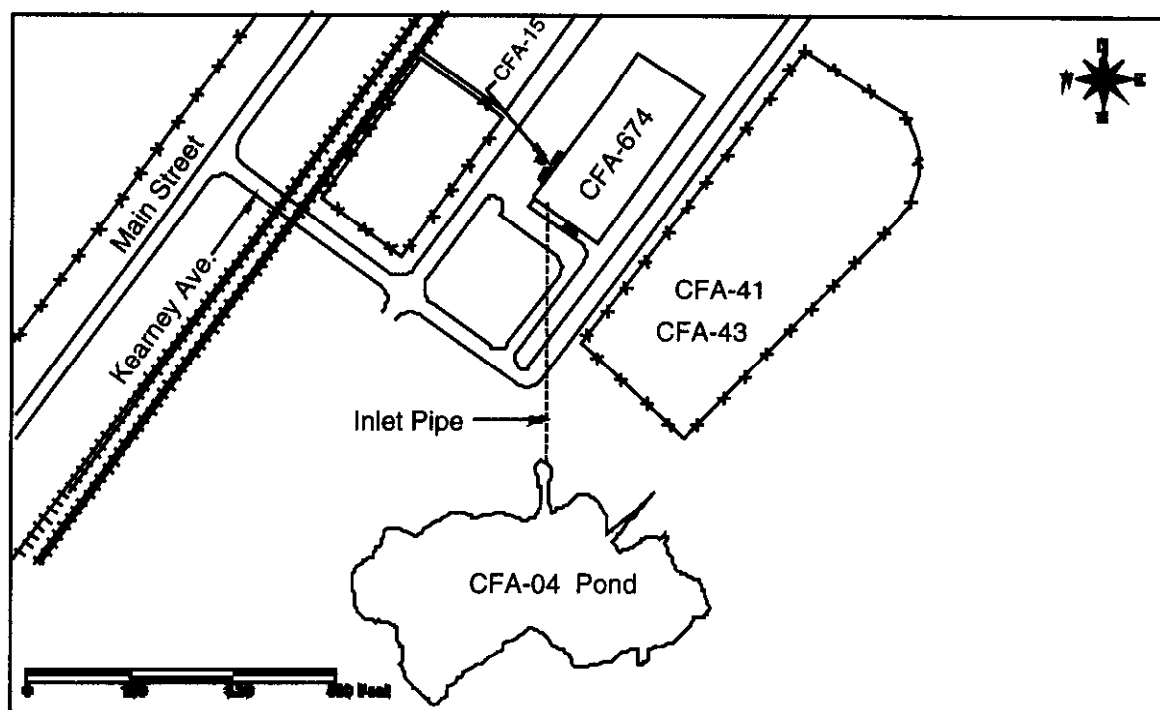
**4.1.3.2 Previous Investigations.** Sampling and analysis efforts were conducted at the site in 1989, 1993, 1994, 1995, and most recently, 1998. The 1989 sampling was of materials contained in bottles collected from the surface of the pond so that bottles exposed at the surface could be remediated. This cleanup was performed as a maintenance activity prior to the FFA/CO. The concentrations of mercury ranged from 0.25 to 73.3 mg/L, which are above the regulatory level of 0.2 mg/L. In 1993, additional sampling was conducted of the bottled material. Analytical results indicated that mercury levels exceeded



Where: C = 95 UCL or maximum detected concentration, whichever is less, for the indicated depth interval.

**Figure 4-4.** CFA-15 assumptions for nature and extent of contamination.





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**Figure 4-5.** OU 4-05: CFA-04 Pond.

the regulatory level, and uranium isotopes and various metals exceeded background concentrations for soil samples. The 1989 and 1993 analytical data were used to initiate a CERCLA removal action at the pond. Surface and subsurface soil samples were collected from the pond and surrounding area in 1994. Analytical results indicated that the soils were contaminated with mercury up to 650 mg/kg.

A time-critical removal action was initiated later in 1994 to remove mercury contamination in the pond. Approximately 2,345 m<sup>3</sup> (3,066 yd<sup>3</sup>) of mercury-contaminated material was removed from the ground including calcine, soil contaminated with calcine, and soil contaminated with mercury from effluent discharges to the pond. Mercury contaminated soil and calcine waste were treated by retorting. However, residual mercury contamination remained in the pond. A small amount of asbestos was also removed from the pond bottom during removal action activities. Non-friable asbestos and roofing material were not disturbed and remained buried in the pond berm.

A Track 2 investigation was conducted in 1995 to characterize residual contamination. Biased surface and subsurface soil samples were collected in the vicinity of the inlet to the CFA-04 pond. A geophysical survey was also performed as part of the investigation to map the distribution of construction rubble, and subsurface metallic objects. The results of the survey indicated geophysical anomalies in two areas; north and west of the CFA-04 pond. The anomalies were believed to be due to elevated soil moisture, soil type change, or the presence of a large volume of conductive, non-metallic material. The shape of the west anomaly, bounded by straight lines, suggested that the feature was a result of human activity. The shape of the northern anomaly was irregular, suggesting elevated soil moisture and/or a soil type change. The identified anomalies north and west of the pond were considered data gaps that required further investigation. The results of the Track 2 investigation sampling indicated that the highest potential human health risks, assuming occupational and residential exposure, were associated with Aroclor-1254, arsenic, mercury, Cs-137, U-234, U-235, and U-238 in the pond soils. The results of the Track 2 risk

assessment indicated that several of these contaminants exceed a risk of 1E-06 and/or a HQ of 1. This site was therefore retained for further evaluation.

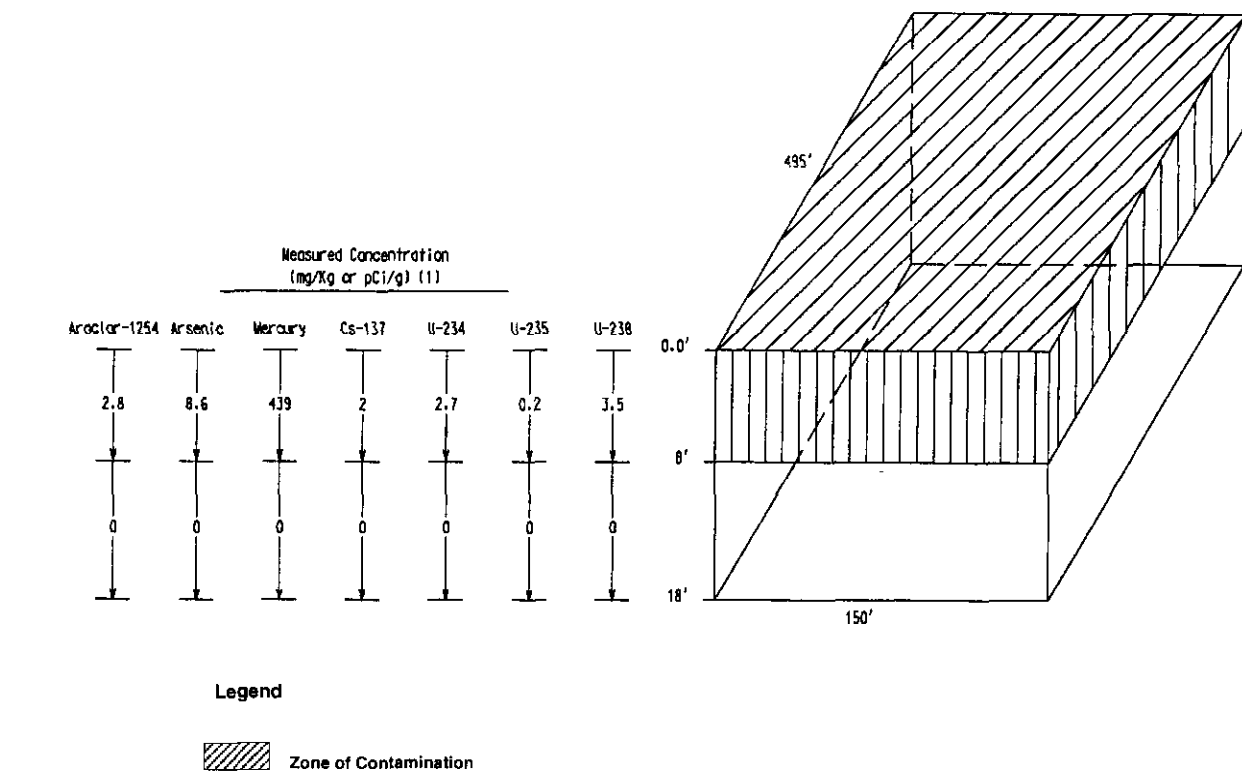
Further sampling was performed in 1997 from the staging area on the north side of the pond where retort equipment was located. The objective of this sampling activity was to determine whether soil contamination occurred as a result of equipment operation and water storage. Samples were collected from 45 surface locations and analyzed for metals, gamma-emitting and uranium radionuclides, and TCLP metals. Mercury was detected at all locations in concentrations ranging from 0.2 to 13.1 mg/kg (Appendix B). These detections indicate that mercury is present in the staging area at concentrations greater than background (0.07 mg/kg) and risk-based concentrations (23 mg/kg). The source of mercury is likely windblown calcine from the pond bottom.

The analytical data discussed above was evaluated for the BRA and it was concluded that additional data was required at the pond to define alternatives for the FS. Because mercury was found in the low areas of the pond bottom and in windblown areas around the pond at relatively high concentrations, the volume of soil that would be considered hazardous under RCRA, became a data gap in the investigation. As a result, additional data was collected in 1998. The primary objective of this activity was to collect the type of data that would be used to estimate the volume of mercury contaminated soil that is above considered hazardous under RCRA. Also, additional total mercury samples were collected to better define the extent of contamination in the pond bottom and windblown area.

Mercury was detected in all of the 1998 locations in concentrations ranging from 0.09 to 268 mg/kg. Data from TCLP analysis indicate that three of the 88 locations in the low areas of the pond bottom are RCRA hazardous (Appendix B). The volume of hazardous soil was estimated to be 608 m<sup>3</sup> (796 yd<sup>3</sup>) using these data. This volume is used in the feasibility study cost estimates to better define the treatment alternative. These data were also incorporated into the nature and extent of contamination and the BRA (Section 4.1.3.3 and Section 6).

**4.1.3.3 Nature and Extent of Contamination.** Data from the 1994, 1995, 1997, and 1998 sampling activities are used in this RI/BRA to characterize the nature and extent of contamination. Samples were collected and analyzed for inorganics, PCBs, metals, radionuclides, VOCs and SVOCs. The initial contaminant screen presented in the RI/FS Work Plan identified Aroclor-1254, arsenic, carbazole, lead, mercury, Cs-137, U-234, U-235, and U-238 as COPCs. The results of the supplemental contaminant screen, presented in Table C-7, Appendix C, indicates Aroclor-1254, arsenic, mercury, Cs-137, U-234, U-235, and U-238 are retained as COPCs for further evaluation in the RI/BRA. Arsenic was detected in 97.9 percent of 95 samples. Mercury was detected in 78.7 percent of 136 samples. Cs-137 was detected in 48 percent of 25 samples. U-234 and U-238 were both detected in 100 percent of 46 samples for each COPC. U-235 was detected in 75.4 percent of 69 samples. The range of detected concentrations of arsenic was 3.1 to 22.4 mg/kg; mercury, 0.12 to 439 mg/kg; Cs-137, 0.0742 to 2 pCi/g; U-234, 0.651 to 22.6 pCi/g; U-235, 0.0225 to 1.6 pCi/g; and U-238, 0.73 to 35 pCi/g.

These data indicate that surface and subsurface soils 0 to 2.4 m (0 to 8 ft) bgs at CFA-04 are contaminated with low levels of arsenic, mercury, Cs-137, U-234, U-235, and U-238. Arsenic is not associated with known waste producing processes at WAG 4; however, arsenic is retained as a COPC for CFA-04 because the maximum detected concentration slightly exceeds the range of measured concentrations at the INEEL. Past waste producing activities at CFA-04 may have resulted in concentrating naturally occurring levels of arsenic at this site. It is assumed that the downward mobility of metals and radionuclides suspended in liquids in the vadose zone (i.e., waste water) is approximately 3.0 m (10 ft). Therefore, contamination is assumed to exist in CFA-04 soils from 0 to 5.5 m (0 to 18 ft) bgs. This assumption is made to ensure that potential risks from exposures at CFA-04 are not



Receptors/Pathways and Calculated Exposure Point Concentrations						
Receptor/Pathway	Units	Depth (ft)	Arsenic	Mercury	Aroclor-1254	
Occupational / Air	mg/kg	0 - 0.5 (1)	7.63E+00	4.36E+02	2.80E+00	
Occupational / External Radiator	mg/kg	0 - 4 (2)	9.84E+00	1.83E+02	2.80E+00	
Residential / All	mg/kg	0 - 10 (2)	1.24E+01	1.17E+02	2.24E+00	
Residential / Groundwater	mg/kg	0 - 18 (2)	1.32E+01	9.75E+01	1.24E+00	

Receptors/Pathways and Calculated Exposure Point Concentrations						
Receptor/Pathway	Units	Depth (ft)	Cs-137	U-234	U-235	U-238
Occupational / Air	pCi/g	0 - 0.5 (1)	2.00E+00	5.84E+00	6.93E-01	9.43E+00
Occupational / External Radiator	pCi/g	0 - 4 (2)	4.51E-01	2.57E+00	3.58E-01	3.47E+00
Residential / All	pCi/g	0 - 10 (2)	2.75E-01	2.18E+00	1.97E-01	2.55E+00
Residential / Groundwater	pCi/g	0 - 18 (2)	2.22E-01	2.07E+00	1.49E-01	2.28E+00

#### Assumptions:

The assumed maximum depth of contamination (i.e., 5.5 m [18 ft]) is based on the conservative assumption that the downward mobility of chemicals detected in the vadose zone at CFA-04 is 3.0 m (10 ft). Positive detections of COPCs in the vadose zone are reported no deeper than 2.4 m (8 ft).

#### Notes:

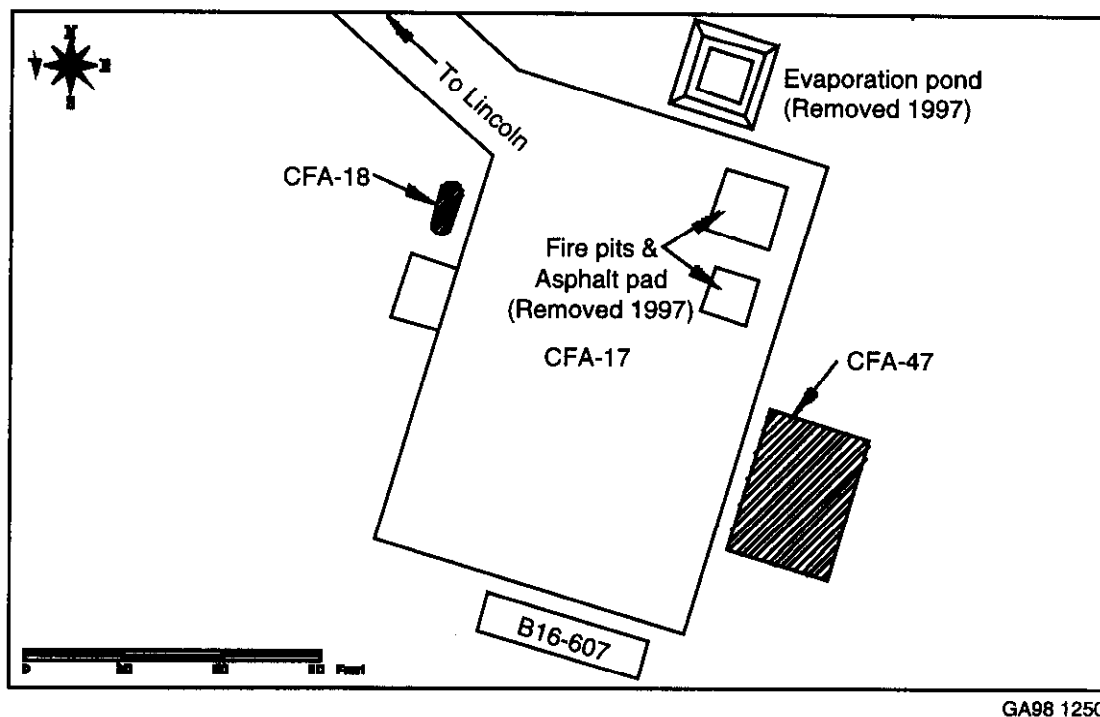
(1) Exposure point concentrations shown for this depth interval represent the 95% lognormal UCL (95 UCL) or maximum detected concentration, whichever is less, for analytical data collected at the site.

(2) Exposure point concentrations (EPC) shown for this depth interval represent volume-weighted concentrations, and are calculated using the following equations:

Depth (ft)	EPC Equation
0-4	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5)]/4$
0-10	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6)]/10$
0-18	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(14)]/18$

Where: C = 95 UCL or maximum detected concentration, whichever is less, for the indicated depth interval.

**Figure 4-6. OU 4-05: CFA-04 nature and extent assumptions.**



**Figure 4-7.** OU 4-05: CFA-17 Fire Department training area (bermed) and CFA-47 Fire Station chemical disposal.

underestimated (Section 6). This assumption is conservative because sample results are not available for depths greater than 2.4 m (8 ft) bgs; however, the entire 0 to 5.5 m (0 to 18 ft) soil interval is assumed to be contaminated.

The extent of the contamination is assumed for purposes of risk calculation to encompass the entire site approximately 6,875 m<sup>2</sup> (74,250 ft<sup>2</sup>) to a depth of 3m (10 ft) which includes the pond, the mercury retort equipment staging area, and the windblowing area. The assumed volume of soil would be 20,955 m<sup>3</sup> (16,022 yd<sup>3</sup>) (Figure 4-6) (Blackmore et al. 1996). The summary statistics for the CFA-04 COPCs, based on the contaminant screening process are shown in Tables C-8 and C-9, Appendix C. Figure 4-6 shows the assumptions for the nature and extent of contamination and source-term estimates and exposure point concentrations used to evaluate potential risks associated with the site.

#### **4.1.4 OU 4-05: CFA-17 Fire Department Training Area (bermed) and CFA-47 Fire Station Chemical Disposal**

**4.1.4.1 Site Summary.** The CFA-17 Fire Department Training Area is located approximately 6 km (4 mi) north of CFA, directly east of Lincoln Boulevard with an area of approximately 1,960.6 m<sup>2</sup> (2,349 yd<sup>2</sup>). The training area at CFA-17 was used by the fire department for fire training exercises from 1958 to 1995. The area consists of an old leach pond and a gravel fire training pad. The leach pond was used to collect wastewater from extinguished fires generated during training exercises. This wastewater contained unburned fuel, products of combustion, and possible solvent residue. The gravel training pad was first used to burn fuel directly on the ground. In 1988 the gravel pad was covered with asphalt; and the area was contaminated with petroleum hydrocarbons (Landis et al., 1998). Approximately 18 m (60 ft) southeast of the CFA-17 asphalt training pad and outside the bermed area, a pile of terphenyls (a brown waxlike substance) and trinitrotoluene (TNT), that resulted from CFA-17 fire station chemical disposal activities, was located at the ground surface in an area approximately 0.93 m<sup>2</sup> (1.1 yd<sup>2</sup>) (see

Figure 4-7) (Blackmore et al. 1996). The terphenyl area is designated as CFA-47 under OU 4-05. CFA-17 and -47 are evaluated in the BRA as a single contaminant source area because they are adjacent and contain similar wastes.

Several upgrades have occurred at the CFA-17 fire training area. The first upgrade included installation of piping to divert wastewater to a shallow drainage ditch along the north and east sides of the asphalt pad. A pipe was also installed to connect the ditch to a leach pond. Following this upgrade, wastewater and unburned fuel would drain to the pond via the drainage ditch. A second upgrade occurred in 1987 in which the leach pond and surrounding area were excavated to remove soil contaminated with unburned fuel, combustion products, solvents, and chemicals. This method of disposal was used from 1981 to 1987. The amount of soil removed is unknown. A third upgrade was performed in 1988, which consisted of replacing the leach pond with a lined evaporation pond and adding asphalt paving over the existing gravel pad.

Additional areas were added to CFA-17 in September, 1994. These areas included the soil around and beneath the existing asphalt pad and the soil surrounding the drafting pit east of the fire training tower. Chemicals from various INEEL facilities were burned directly on the gravel pad or in containers at the training area. The soil near the drafting pit was included because unused non-radioactive, sodium-potassium (NaK) from the Experimental Breeder Reactor I was processed in 1970. The drafting pit, normally used to test fire truck pumps, was used to process the NaK. Processing was performed by piping the NaK to nozzles in the bottom of the drafting pit, which was filled with an aqueous solution of sodium and potassium hydroxide. An exothermic reaction occurred when the nozzles malfunctioned, causing the solution to boil and overflow the drafting pit. Approximately 75,700-L (20,000-gal) of the solution drained to the ground in an area east of the pit. The solution contained sodium and potassium salts. The estimated maximum quantity of NaK released during the process was 2,500-L (660 gal).

**4.1.4.2 Previous Investigations and Removal Action.** The Track 2 investigation (Blackmore et al. 1996) conducted in 1995 determined the type and concentration of contaminants originating from the fire training exercises at CFA-17 and determined the extent of terphenyls and other potential contaminants. Soil samples collected from the leach pond and the ditch between the pond and the fire training pad were analyzed for VOCs, SVOCs, metals, and PCBs.

The analytical results of the Track 2 investigation for CFA-17 indicated that acetone, SVOCs, and Aroclor-1260 were detected, and several metals had concentrations above background. The results of the Track 2 risk assessment indicated that HQs are all less than 1, and human health risks above 1E-06 are present for several SVOCs, and arsenic at the leach pond and drainage ditch. CFA-17 was therefore included in the *WAG 4 Miscellaneous Sites 1997 Non-Time Critical Removal Action*.

The Track 2 investigation for CFA-47 (Blackmore et al. 1996) determined the extent of terphenyls and other potential contaminants including metals, VOCs, SVOCs, and PCBs. The results of the Track 2 risk assessment indicated human health risks above 1E-06 are present and all HQs are less than 1. According to the CFA-47 Track 2 Summary Report (Blackmore et al. 1996), PAHs are expected to migrate on the ground surface, through water and/or wind erosion. CFA-47 was therefore also included in the *WAG 4 Miscellaneous Sites 1997 Non-Time Critical Removal Action*.

Excavation activities began August 4<sup>th</sup>, 1997 with removal of the asphalt and concrete burn basins. Discoloration and petroleum odors were evident after removal of these structures indicating the presence of contaminated soil. Excavation of petroleum contaminated soil was guided by visual contamination and data collected by a photoionization detector (PID). Contaminated soil was removed down to basalt at depths ranging from 3 m (10 ft) at the north end to 7.3 m (24 ft) at south end of the excavation, which represents the varying depths to basalt. The total volume of petroleum-contaminated soil removed from

the site was 4,051 m<sup>3</sup> (5,298 yd<sup>3</sup>). Contamination is still present at the site in the basalt. Terphenyls at CFA-47 were removed from the surface soil.

The wastes excavated from the area included petroleum-contaminated soil and sludge, concrete debris from the basins, asphalt, and piping. The petroleum-contaminated soil and sludge was disposed at the CFA Landfarm for treatment. The concrete and asphalt were disposed at the CFA bulky waste landfill. The piping was cleaned and also disposed at the bulky waste landfill. The excavation was backfilled with gravel from the INEEL. Topsoil, from the INEEL spreading area B, was placed on the surface of the backfill and seeded.

The excavation under the asphalt pad area continued until no contamination was observed based on soil color, odor and when PID readings were low to nondetect. Clean backfill for this excavation was obtained from the TSA gravel pit. Soil used for topsoil was taken from Spreading Area "B." This soil was used to provide material for reseeding efforts. Reseeding was performed using a hydroseeder. The total amount of soil removed from CFA-17/47 was 4,051 m<sup>3</sup> (5,298 yd<sup>3</sup>).

**4.1.4.3 Nature and Extent of Contamination.** The initial contaminant screen presented in the Work Plan eliminated metals and SVOCs from further evaluation, and identified Aroclor-1260, arsenic, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, lead, and phenanthrene. The results of the supplemental contaminant screen, presented in Table C-10, Appendix C, indicates benzo(g,h,i)perylene and phenanthrene are retained as COPCs for further evaluation in the BRA. Benzo(g,h,i)perylene was detected in 2.3 percent of 43 samples. Phenanthrene was detected in 4.7 percent of 43 samples. The maximum detected concentration of benzo(g,h,i)perylene was 0.16 mg/kg; phenanthrene was detected from 0.0252 to 0.14 mg/kg.

Arsenic, lead, and Aroclor-1260 were not included in the post-removal action sampling analyses. The arsenic concentrations that were detected in the OU 4-05 Track 2 sampling ranged from 11 mg/kg to 6.1 mg/kg. These concentrations are slightly above the INEEL arsenic background concentration of 5.8 mg/kg as reported in Rood (1995). The contamination generating activities at CFA-17/47 would not have produced arsenic contamination, so the detected arsenic concentrations are believed to be naturally occurring.

The maximum lead concentration that was detected in the Track 2 sampling was 28.5 mg/kg. This concentration is higher than the INEEL lead background concentration of 17 mg/kg, but it is much lower than the 400 mg/kg residential lead clean up standard that has been established by the EPA.

The Aroclor-1260 concentration that were detected in the Track 2 sampling ranged from 0.12 mg/kg to 0.062 mg/kg. Aroclor-1260 was detected in 3 samples out of 13 at a depth of 0-0.5 ft. The maximum detected concentration is slightly higher than the EPA Region III risk-based concentration for PCBs (0.083 mg/kg), so any PCB contamination that remains at the site is unlikely to produce a large impact to human health or the environment.

The omission of these three contaminants from the post-removal action sampling produces some uncertainty in the site's risk assessment. A discussion of the uncertainty produced by undetected contamination can be found in Section 6.6.

Measured concentrations collected at CFA-17/47 indicate that subsurface soils (0.15 to 0.9 m [0.5 to 3 ft] bgs) at CFA-17/47 are contaminated with low levels of benzo(g,h,i)perylene and phenanthrene. During the 1997 removal action, basalt was encountered from 0.9 to 6.1 m (3 to 20 ft) bgs. Residual contamination is assumed to occur above the 6.1 m (20 ft) assumed site-wide depth to basalt. The

residual contamination is not expected to migrate beyond 6.1 m (20 ft) bgs due to the presence of basalt at this depth.

It is assumed that the downward mobility of PAHs suspended in liquids in the vadose zone (i.e., waste water) is approximately 3.0 m (10 ft) (DOE 1997). Therefore, contamination is assumed, for risk assessment purposes, to exist in CFA-17/47 soils from 0 to 4 m (0 to 13 ft) bgs. This assumption is made to ensure that potential risks from exposures at CFA-17/47 are not underestimated (Section 6). This assumption is conservative because sample results are not available for depths greater than 0.9 m (3 ft); however, the entire 0 to 4 m (0 to 13 ft) soil interval is assumed to be contaminated.

The extent of the contamination is assumed to encompass the entire area of CFA-17 and CFA-47 [approximately 1,968 m<sup>2</sup> (21,185 ft<sup>2</sup>) for the entire area: 1,967 m<sup>2</sup> (21,175 ft<sup>2</sup>) for CFA-17, and 0.93 m<sup>2</sup> (1.0 yd<sup>2</sup>) for CFA-47]. The volume of soil associated with the contamination at CFA-17/47 is 7,872 m<sup>3</sup> (10,200 yd<sup>3</sup>) [CFA-17 volume is 7,868 m<sup>3</sup> (10,195 yd<sup>3</sup>) and CFA-47 volume is 12.1 m<sup>3</sup> (130 ft<sup>3</sup>)] (Figure 4-8) (Blackmore et al. 1996). The summary statistics for the CFA-17/47 COPCs, based on the contaminant screening process are shown in Tables C-11 and C-12, Appendix C. Figure 4-8 shows the assumptions for the nature and extent of contamination and source-term estimates (i.e., exposure point concentrations) that are used to evaluate potential risks associated with the site.

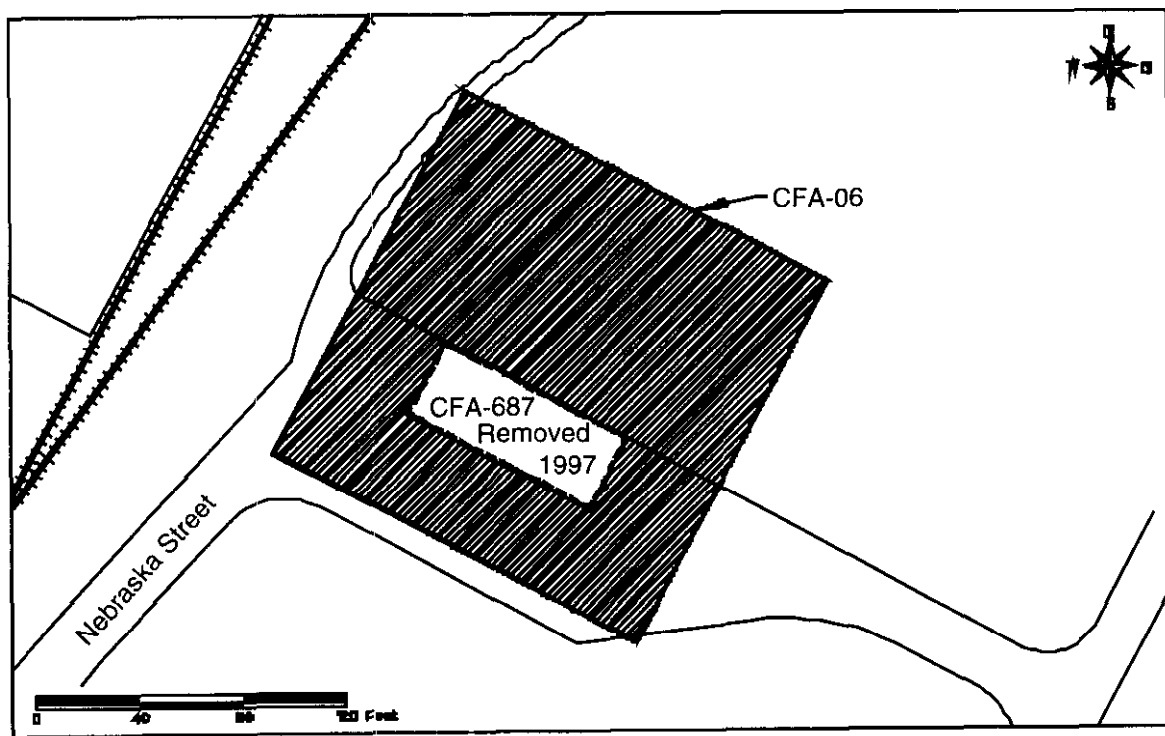
#### **4.1.5 OU 4-06: CFA-06 Lead Shop (Outside Areas)**

**4.1.5.1 Site Summary.** This site consists of the area surrounding Building CFA-687 (see Figure 4-9). CFA-687 was used for lead recycling from 1953 to 1986. Lead scrap from INEEL operations was shipped to CFA-687 and temporarily stored on the ground outside the building until it was processed. CFA-06 is comprised of a 2,529 m<sup>2</sup> (3,024 yd<sup>2</sup>) area, located predominately north and northeast of the previously existing building. No records exist on actual quantities of lead scrap stored near the building. Lead storage resulted in surface and subsurface soil contamination. The lead recycling shop ceased operations in 1986, is no longer used for lead storage or processing and was demolished during the summer of 1997.

**4.1.5.2 Previous Investigations.** This site was included in the OU 4-06 time-critical removal action initiated in June 1996 to reduce the risks associated with lead and arsenic. Pre-removal screening samples were collected at CFA-06 to establish the boundaries of lead contamination. A total of 76 soil samples were collected for lead analysis from the 0 to 15 cm (0 to 6 in) or 15 to 30 cm (6 to 12 in) depths. Sixty of these samples were analyzed for total arsenic. The removal action consisted of removing soil contaminated with lead and arsenic to levels below 400 mg/kg for lead, and 23 mg/kg for arsenic.

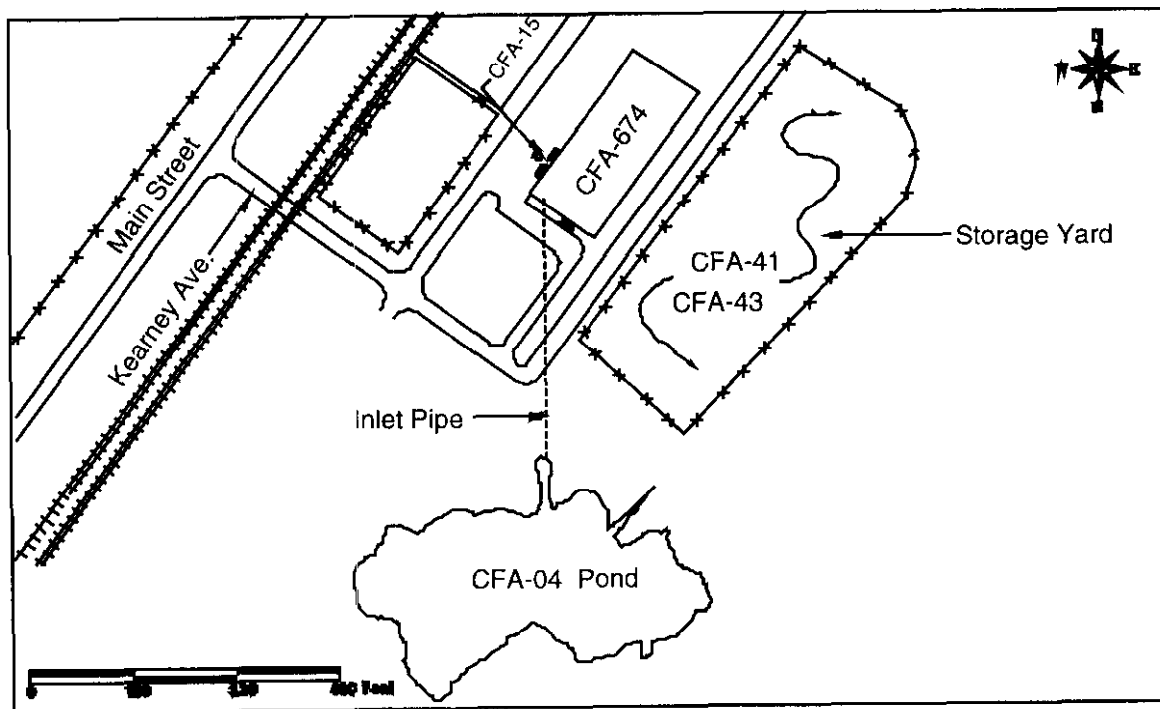
Approximately 153 m<sup>3</sup> (200 yds<sup>3</sup>) of soil, asphalt, lead shot and scrap were excavated. Contaminated soil was shipped off-site to a treatment storage and disposal facility, and lead scrap was recycled. After removal of the contaminated soil, 32 verification samples were collected for total lead analysis and 28 for total arsenic (DAR Nos. ER-DAR-419 and ER-DAR-446) (Higgins 1997). All lead concentrations were below the EPA (1994) lead screening level of 400 mg/kg. All arsenic concentrations were below the arsenic cleanup goal of 23 mg/kg for residential soils.

**4.1.5.3 Nature and Extent of Contamination.** The analytical data from verification samples indicate that residual contamination at CFA-06 consists of low levels of arsenic that exceed the risk-based concentration of 0.43 mg/kg, but are below the 23 mg/kg cleanup goal (detections ranged from 10.4 to 14.5 mg/kg) and lead detected below the 400 mg/kg screening level (detections ranged from 10.4 to 153 mg/kg) in the top 15 cm (6 in) of soil (see Table C-14, Appendix C). Based on the supplemental contaminant screening which used the maximum detected verification results, these contaminants are no longer considered COPCs (Table C-13, Appendix C). Detected concentrations of arsenic are not source



GA98 1251

**Figure 4-8.** OU 4-05: CFA-17/47 nature and extent assumptions.



GA98 1261

**Figure 4-9.** OU 4-06: CFA-06 Lead Shop (outside areas).

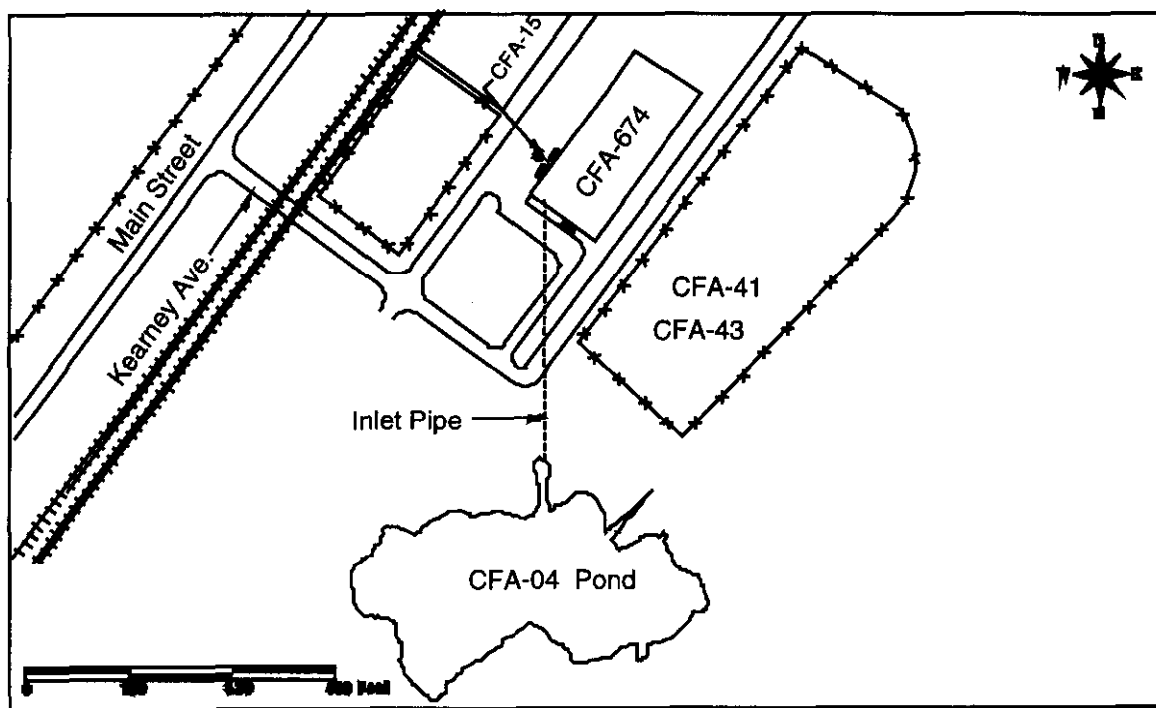


related and are assumed to be within the range of background concentrations for INEEL soils. Lead is below screening levels. Arsenic and lead are therefore eliminated as COPCs; therefore, this site is eliminated further consideration in the RI/BRA.

#### 4.1.6 OU 4-06: CFA-43 Lead Storage Area

**4.1.6.1 Site Summary.** This site consists of a storage yard south of Building CFA-674 (see Figure 4-10). From 1940 to 1988, this site was used for storage of excess materials, including scrap lead and batteries. In 1988, a molten lead spill of approximately 4.5 kg (10 lb) occurred along the southwest fenced area, which may have resulted in soil contamination. The spilled lead was allowed to harden, was raked up and recycled. The storage area has been regraded several times since 1988. Following the removal action at OU 4-06 in October 1996, the storage area was covered with a clean layer of packed gravel. The area is currently fenced and contains used office furniture and other stored nonhazardous equipment and supplies for private market sale or disposal.

**4.1.6.2 Previous Investigations.** This site was included in the OU 4-06 time-critical removal action to reduce the risks associated with lead and antimony. Prior to removal action activities, pre-removal action sampling was conducted to establish the boundaries of lead contamination at CFA-43. A total of 213 soil samples were collected and analyzed for total lead. Of the 213 samples, 37 were also analyzed for total antimony. Twenty-three total lead samples were greater than the EPA (1994) lead screening level (400 mg/kg). None of the antimony samples exceeded the antimony risk-based screening concentration (31 mg/kg) for residential soils (Higgins 1997); further action was therefore not required for antimony.



GA98 1260

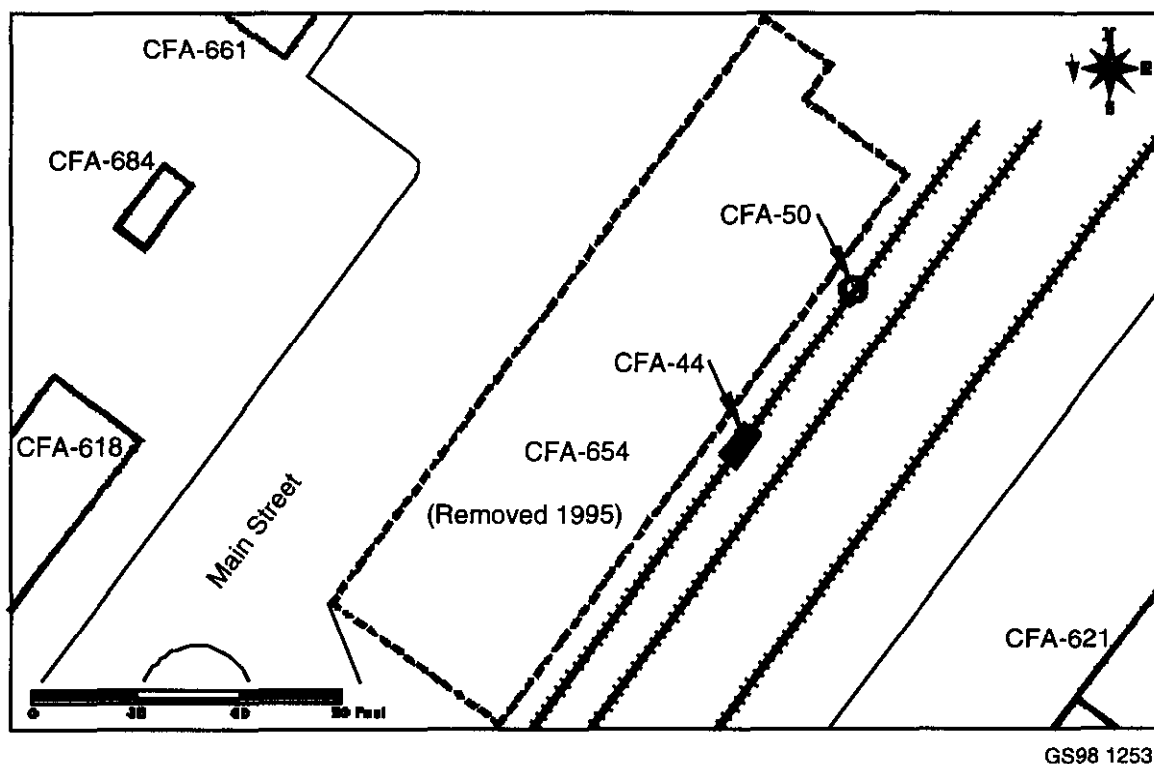
**Figure 4-10.** OU 4-06: CFA-43 Lead Storage Area.

**4.1.6.3 Nature and Extent of Contamination.** The removal action consisted of removing soil contaminated with lead to a level below the 400 mg/kg lead screening level. Approximately 304 m<sup>3</sup> (400 yd<sup>3</sup>) of contaminated soil was excavated and shipped off-site to a treatment, storage and disposal facility. Sixty-five samples, representing post-removal verification samples, were submitted for total lead analysis. Sixty-four of the samples had total lead concentrations below the 400 mg/kg lead screening level. One of the 65, however, exceeded the total lead screening level of 400 mg/kg with a concentration of 650 mg/kg. This location was re-excavated and resampled for total lead. This verification sample result for the re-excavated area was below 400 mg/kg.

Post-removal verification analytical results for CFA-43 indicate that lead at the site is below the EPA (1994) lead screening level of 400 mg/kg and therefore has been adequately remediated (see Tables C-15 and C-16, Appendix C). Based on these results, CFA-43 is eliminated from further consideration in the BRA.

#### 4.1.7 OU 4-06 CFA-44 Spray Paint Booth Drain (CFA-654)

**4.1.7.1 Site Summary.** This site consists of a drain outlet from a spray paint booth on the east side of Building CFA-654, where various types of paints such as epoxy, latex, and enamel were used (see Figure 4-11). These materials were used from 1952 to 1983. The spray booth used a water curtain system to scrub paint particles from the air before it was discharged to the atmosphere. Water was recycled through the system and reused in the water curtain. The water was treated using coagulants and



**Figure 4-11.** OU 4-06: CFA-44 Spray Paint Booth Drain (CFA-654).

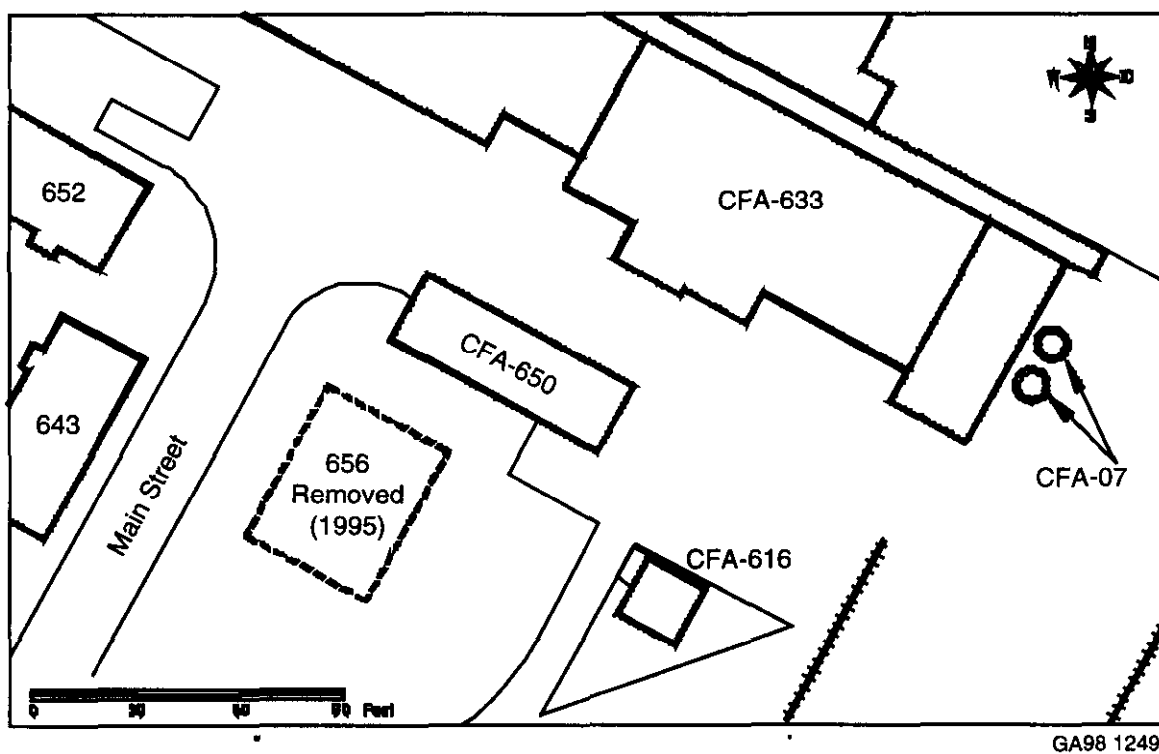
flocculants to settle out the solids, which were then collected in a sump and disposed in the CFA Landfill until disposal procedures were changed and the solids were disposed as hazardous waste. Treated wastewater without solids was discharged from the booth to the drain system and then onto the ground approximately once per month. Solvents containing VOCs in the paint booth ventilation air that would have been removed by the water curtain would also have been re-entrained and emitted to the atmosphere.

**4.1.7.2 Previous Investigations.** Contamination at the CFA-44 site was estimated, based on the Track 2 investigation, to extend over a  $1 \text{ m}^2$  ( $1.2 \text{ yd}^2$ ) area to a depth of approximately 1 m (3.3 ft). Screening samples were collected as part of the 1996 OU 4-06 time-critical removal action to determine whether total lead concentrations exceeded the EPA (1994) 400 mg/kg residential lead screening level. Five screening samples were collected from within the  $1 \text{ m}^2$  ( $1.2 \text{ yd}^2$ ) area for total lead analysis: three from the surface, one from approximately 1.2 m (4 ft) below ground surface (bgs), and one at basalt, approximately 4.5 m (15 ft) bgs. The analytical sample results indicate that the total lead concentrations at the CFA-44 site were less than the 400 mg/kg screening level (see Tables C-17 and C-18, Appendix C). Therefore, no further action was necessary at the site (Higgins 1997).

**4.1.7.3 Nature and Extent of Contamination.** Analytical results from the screening samples collected at CFA-44 indicate that lead at the site is below the EPA (1994) 400 mg/kg screening level. Therefore, CFA-44 is eliminated from further consideration in the BRA.

#### 4.1.8 OU 4-07: CFA-07 French Drains (CFA-633)

**4.1.8.1 Site Summary.** This site consisted of two french drains (commonly referred to as the north and south drains) located southeast of Building CFA-633 (see Figure 4-12). The french drains received laboratory wastewater from 1951 to 1984, via inflow pipes from a laboratory in the southwest corner of



**Figure 4-12.** OU 4-07: CFA-07 French Drains E/S (CFA-633).

Building CFA-633. The wastes typically consisted of acids and bases with low levels of radioactivity. There is no indication that large quantities of chemicals were released to the drains, and the laboratory did not keep records of the quantities of waste discharged.

**4.1.8.2 Previous Investigations.** A Track 1 investigation (DOE 1994a) was completed in October 1994 to gather historical, empirical, and process data for the CFA-07 french drains. The Track 1 decision indicated that CFA-07 be further investigated under the Track 2 process. As part of the Track 2 investigation, the north and south drains were removed in August 1995 (Gianotto et al. 1996). At the north drain, all of the drain structure and discolored soil encountered during the removal were excavated, resulting in a 3.7 m (12 ft) deep excavation. At the south drain, radioactively contaminated soil was encountered at approximately 3 m (10 ft). Excavation continued, and the drain structure and soil were excavated to a depth of approximately 3.9 m (13 ft). Excavation was stopped at this depth for the following reasons:

- All of the materials associated with the drain structure had been removed,
- The depth of the excavation was in excess of 10 ft bgs.
- The lateral extent of contamination at depths less than 13 ft bgs had been determined.
- The levels of radioactivity being detected were relatively low.

Data from verification samples was modeled using GWSCREEN (Version 2.02) (Rood 1993) to determine the potential risk to groundwater receptors as part of the Track 2 Investigation. The model results indicated that arsenic posed a potential carcinogenic risk of  $3\text{E-}06$ , which is within the acceptable risk range. It was also determined that lead was present at 13 to 13.5 ft bgs in concentrations ranging from 1,460 to 4,580 mg/kg, which is above the EPA screening level of 400 mg/kg.

Track 2 verification soil sampling was performed at the CFA-07 south drain on August 1, 1995. The first sample, from the south drain, was collected from a depth of 3.9 to 4.1 m (13 to 13.5 ft) bgs on the west side of the excavation directly below where the drain was removed. The second and third samples were collected from the same depth from the east and north sides of the excavation floor, respectively. Samples were analyzed for gamma spectroscopy, Am-241, Sr-90, U isotopes, Pu isotopes, metals, and SVOCs.

Track 2 verification sampling at the CFA-07 north drain was performed in August, 1995. Three verification samples were collected from the excavation floor below where the drain had been removed at a depth of approximately 3.7 m (12 ft) bgs. Samples were analyzed for the same suite of analytes as the south drain. The analytical results indicate that antimony, chromium, copper, lead, mercury, selenium, and silver concentrations were elevated over background levels in one or more of the samples collected from the south drain excavation. Arsenic, chromium, copper, lead, mercury, and silver concentrations were elevated over background levels in one or more of the samples from the north excavation. Lead concentrations in the south drain excavation and chromium concentrations in both drains were particularly elevated. Chrysene, bis(2-ethylhexyl)phthalate, and di-n-butyl phthalate were the only SVOCs detected in the samples; all detections were at low concentrations (i.e., below residential soil risk-based screening concentrations of 8.77 mg/kg, 45.7 mg/kg, and 27,000 mg/kg, respectively) (DOE-ID 1997).

The verification data indicate that the following radionuclides were elevated above background: Pu-238, Pu-239/240, Am-241, and Cs-137. Pu-238 was detected in one of the two samples collected

from the south drain excavation. Activities ranged from 4.8 to 9.3 pCi/g in the north drain soils. Pu-239 or 240 (the analysis does not distinguish between the two isotopes), Am-241, and Cs-137 were detected in all six of the samples collected. Activities of Pu-239/240, Am-241, and Cs-137 ranged from 0.78 to 3.1 pCi/g, 0.12 to 0.34 pCi/g, and 26.3 to 104 pCi/g, respectively. Co-60 and Ag-108m were also detected at low activities (i.e., from 0.13 to 3.6 pCi/g and from 0.29 to 0.43 pCi/g, respectively), primarily in the samples from the CFA-07 north drain.

**4.1.8.3 Nature and Extent of Contamination.** The initial contaminant screen presented in the RI/FS Work Plan eliminated various metals, SVOCs, and radionuclides from further evaluation. The results of the supplemental contaminant screen, presented in Table C-19, Appendix C, also indicate that arsenic is within the range of background concentrations for INEEL soils. Arsenic is therefore eliminated as a COPC. Based on these contaminant screens, the COPCs at CFA-07 retained for further evaluation are: lead, Ag-108m, Cs-137, and Pu-238. The range of detected concentrations of these COPCs is as follows:

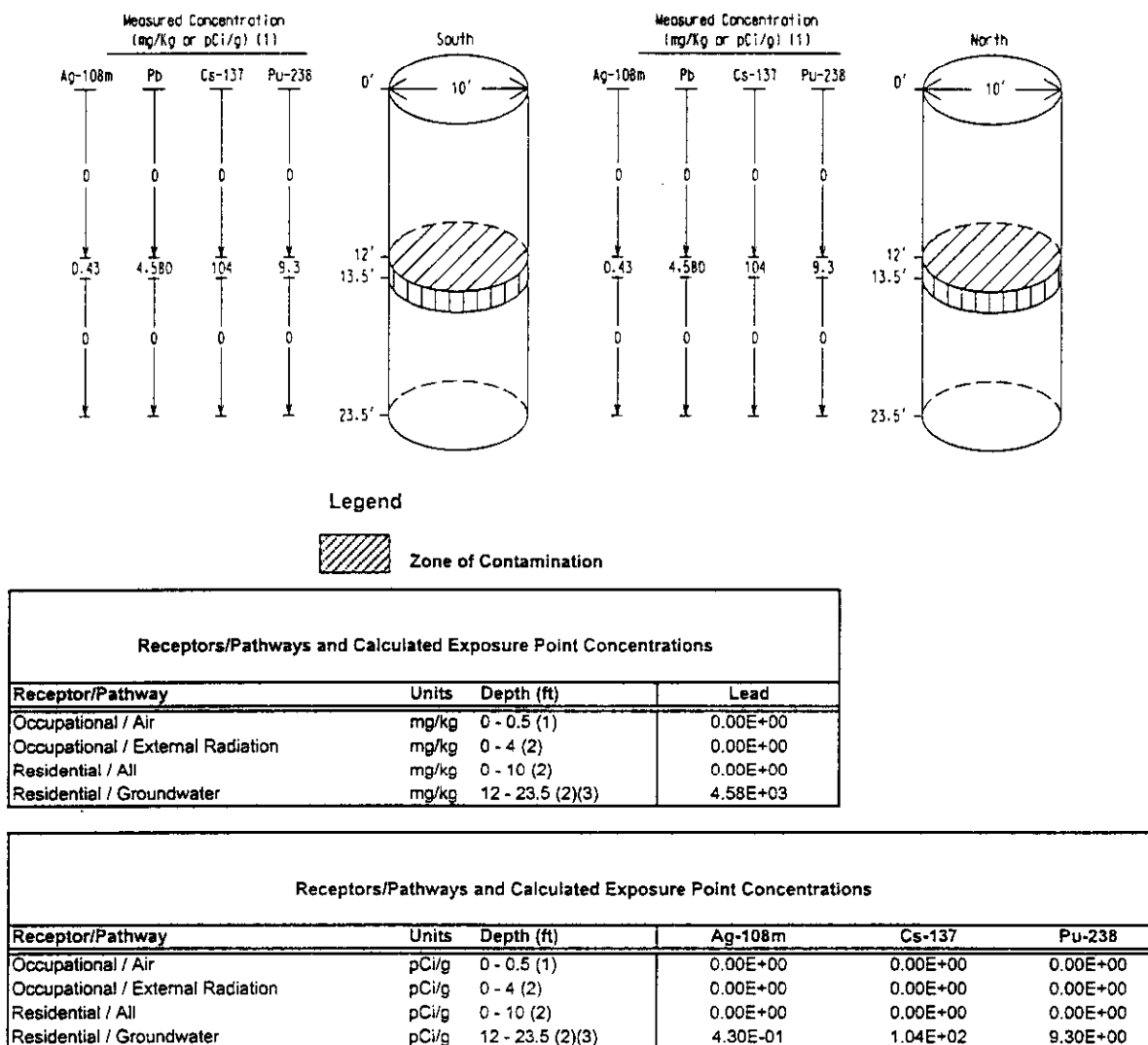
Lead	74 to 4,580 mg/kg
Ag-108m	0.29 to 0.43 pCi/g
Cs-137	26.3 to 104 pCi/g
Pu-238	0.08 to 9.3 pCi/g

Measured concentrations indicate that subsurface soils [3.7 m (12 ft) bgs from the north drain and 3.96 to 4.1 m (13 to 13.5 ft) bgs at the south drain] at CFA-07 are contaminated with lead and radionuclides (i.e., Ag-108m, Cs-137, Pu-238). Basalt was not encountered during the removal action. It is assumed that the downward mobility of metals and radionuclides suspended in liquids in the vadose zone (i.e., waste water) is approximately 3.0 m (10 ft) (DOE 1997). Therefore, contamination is assumed to exist in CFA-07 soils from 3.7 to 7.1 m (12 to 23.5 ft) bgs. This assumption is made to ensure that potential risks from exposures at CFA-07 are not underestimated (Section 6). This assumption is conservative because sample results are not available for depths greater than 4.1 m (13.5 ft) bgs; however, the entire 3.7 to 7.2 m (12 to 23.5 ft) soil interval is assumed to be contaminated.

In summary, the extent of contamination at the site begins at 3.7 m (12 ft) bgs, extends to 7.2 m (23.5 ft) bgs, and encompasses the area of CFA-07, approximately 14.6 m<sup>2</sup> (17.5 yd<sup>2</sup>) (Figure 4-13). The volume of soil assumed to be associated with the contamination at CFA-07 is 51 m<sup>3</sup> (66.7 yd<sup>3</sup>). Based on the contaminant screening results and the nature and extent of the COPCs detected in subsurface soils at CFA-07, the site is retained for further evaluation of cumulative risk associated with the groundwater pathway. The summary statistics for the CFA-07 COPCs, based on the contaminant screening process are shown on Tables C-20 and C-21, Appendix C. Figure 4-13 shows the assumptions for the nature and extent of contamination and source-term estimates that are used to evaluate cumulative risk associated with the groundwater pathway in Section 6 of this BRA.

#### **4.1.9 OU 4-07: CFA-12 French Drains (2) (CFA-690)**

**4.1.9.1 Site Summary.** This site consists of two french drains (commonly referred to as the north and south french drains) located east of the north corner of Building CFA-690, which housed several laboratories and offices operated by the DOE Radiological and Environmental Sciences Laboratory (RESL) (see Figure 4-14). The french drains were unlined concrete cylinders approximately 0.6 m (2 ft) in diameter. The bottom of the drains were 1.8 m (6 ft) bgs. Process knowledge indicates that the types



#### Assumptions:

Site was excavated to approximately 3.7 m (12 ft) and backfilled.

The assumed maximum depth of contamination (i.e., 7.2 m [23.5 ft] ) is based on the conservative assumption that the downward mobility of chemicals detected in the vadose zone at CFA-07 is 3.0 m (10 ft). Positive detections of COPCs in the vadose zone are reported no deeper than 4.1 m (13.5 ft).

#### Notes:

- (1) Exposure point concentrations shown for this depth interval represent the 95% lognormal UCL (95 UCL) or maximum detected concentration, whichever is less, for analytical data collected at the site.
- (2) Exposure point concentrations (EPC) shown for this depth interval represent volume-weighted concentrations, and are calculated using the following equations:

#### Depth (ft)

0-4

0-10

12-23.5

#### EPC Equation

$$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5)]/4$$

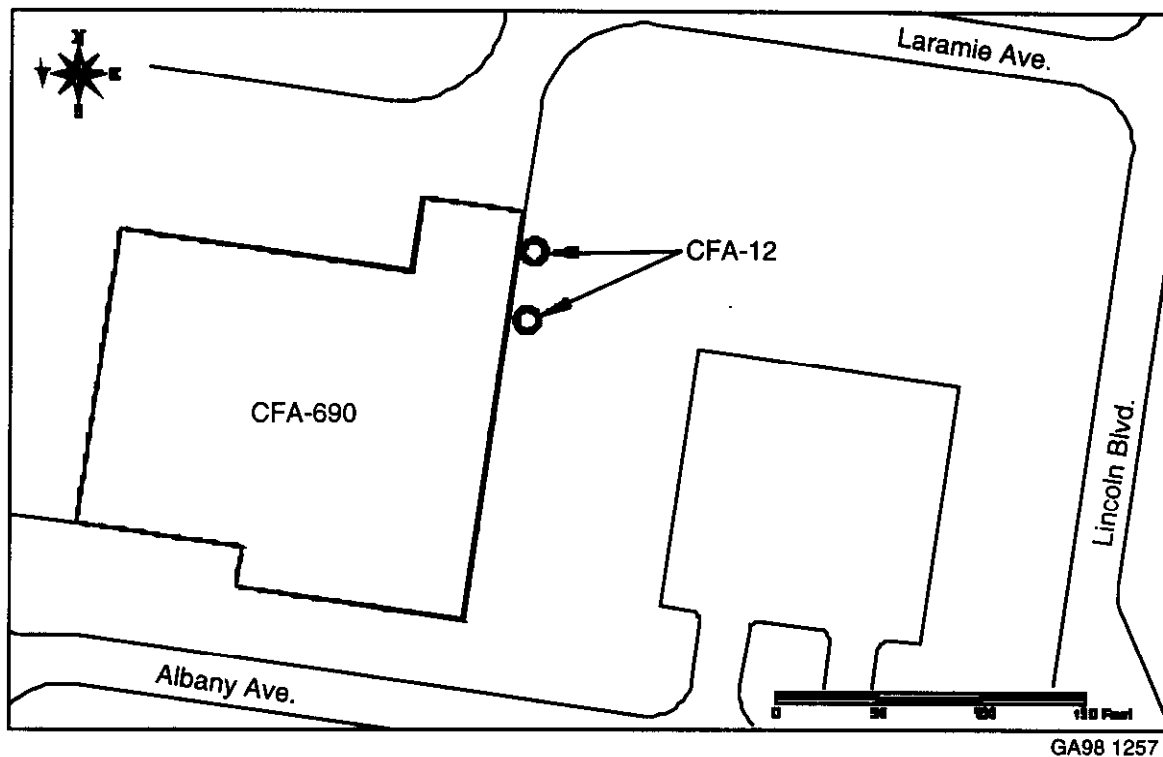
$$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6)]/10$$

$$C_{>10}$$

Where: C = 95 UCL or maximum detected concentration, whichever is less, for the indicated depth interval.

- (3) COPCs are only detected from 3.7 to 4.1 m (12 to 13.5 ft). Exposure point concentrations for the residential groundwater pathway are based on measured concentrations from this depth interval.

**Figure 4-13.** OU 4-07: CFA-07 nature and extent assumptions.



**Figure 4-14.** OU 4-07: CFA-12 French Drains (2) (CFA-690) (south drain only).

of waste disposed in the drains via sink in the laboratory included dilute acids, containing low levels of radioactivity. Use of the sinks was discontinued in 1984, and the floor drains were capped inside the building.

**4.1.9.2 Previous Investigations.** A Track 1 investigation (DOE 1994b) was completed in October 1994 to gather historical, empirical, and process data from the CFA-12 french drains (Gianotto et al. 1996). Soil samples collected from both drains were analyzed for metals and radionuclides. Several metals were detected in both drains above background concentrations. The results of the radiological analyses indicate that only the south drain was radiologically contaminated.

Table 4-1 of the OU 4-09 Track 2 Summary Report (Gianotto et al., 1996) shows that the 1993 sampling of the drain sediments produced maximum detections of cadmium, calcium, mercury, and lead that exceeded INEEL background concentrations. At the time the drains were removed, these relatively low concentrations were not considered to be significant, so the post removal action samples were not tested for metals. All of the metal contamination that was detected in the 1993 sampling was removed with the drains, but there is a small chance that low levels of metal contamination still exist in the basalt beneath the drains.

On the basis of these results, it was decided to further investigate the site in a Track 2 investigation in conjunction with a removal action. The goal of the investigation was to (1) determine if past disposal to the drains resulted in actual or potential risks to receptors (Blackmore 1995), (2) to characterize soil contamination beneath the drains and (3) determine the proper method(s) for disposal and/or treatment of contaminated materials.

The removal action was performed in July 1995, concurrent with the OU 4-09 Track 2 investigation (Gianotto et al. 1996). Soil was removed to a depth of approximately 2.4 m (8 ft). Following the removal of the two drains, verification samples were collected to determine contaminant levels. Verification samples from the north french drain were analyzed for VOCs, SVOCs, pesticides, and PCBs. The only contaminant detected in the north french drain was pentachlorophenol at a concentration of 190 ug/kg. Results of the contaminant screening presented in the RI/FS Work Plan indicate that pentachlorophenol is below the risk-based concentration of 5.73 mg/kg. As a result, the north french drain was screened from further evaluation.

Verification samples at the south french drain were collected at 2.6 m (8.5 ft) bgs from a subsurface basalt fracture and were analyzed for SVOCs, gamma spectroscopy, and alpha/beta isotopes. Several radionuclides detected in the soil samples collected from the south drain excavation were slightly above background concentrations. These elevated radionuclide activities were detected in a subsurface basalt fracture located northeast of the south french drain. Remaining contamination at the site is in the basalt.

**4.1.9.3 Nature and Extent of Contamination.** The initial contaminant screen presented in the RI/FS Work Plan eliminated SVOCs and several radionuclides from further evaluation. The results of the supplemental contaminant screen presented in Table C-22 of Appendix C indicates that Ag-108m, Am-241, Ba-133, Cs-137, Eu-152, U-235, and U-238, should be retained for further evaluation in the RI/BRA. The detection frequency for Ag-108m, Am-241, Ba-133, Cs-127, Eu-152, U-238, is 100 percent. U-235 was detected in 50 percent of the samples. The range of detected concentrations is as follows:

Ag-108m	2.46 pCi/g (only one positive detection is reported)
Am-241	0.09 to 23.7 pCi/g
Ba-133	0.77 pCi/g (only one positive detection is reported)
Cs-137	10.2 to 1,070 pCi/g
Eu-152	10.6 pCi/g (only one positive detection is reported)
U-235	1.2 to 2.4 pCi/g
U-238	0.8 to 18.3 pCi/g

The Track 2 measured concentrations indicate that subsurface soils [2.6 m (8.5 ft) bgs] at the south drain of CFA-12 are contaminated with low levels of radionuclides (i.e., Ag-108m, Am-241, Ba-133, Cs-137, Eu-152, U-235, U-238).

Excavation of contaminated soils from 0 to 2.6 m (0 to 8.5 ft) bgs was conducted in July 1995. The soils in this depth interval are clean because they have been backfilled with clean soil. The extent of contamination at the site exists at 2.6 m (8.5 ft) bgs (the depth at which basalt was encountered), and encompasses the area of the CFA-12 south drain (approximately 13.4 m<sup>2</sup> [16.0 yd<sup>2</sup>]). Because soils at CFA-12 have been remediated and the area backfilled with clean soil, the residual contamination, which is present at 2.6 m (8.5 ft) bgs, occurs in the basalt. The volume of soil associated with contamination bgs at CFA-12 is assumed to extend from 0 to 2.6 m (0 to 8.5 ft) and is 35 m<sup>3</sup> (45.8 yd<sup>3</sup>) for the future residential risk evaluation (Section 6). Although contamination does not exist from the surface to basalt, the entire interval is evaluated due to a potential excavation of soils for a future residential scenario. This



assumption is made to ensure that potential risks from exposures to CFA-12 are not underestimated (Section 6). This assumption is conservative because sample results are not available for depths greater than 2.6 m (8.5 ft) bgs; however, the entire 0 to 2.6 m (0 to 8.5 ft).

The summary statistics for the CFA-12 COPCs, based on the contaminant screening, are shown in Tables C-23 and C-24, Appendix C. Figure 4-15 shows the assumptions for the nature and extent of contamination and source-term estimates (i.e., exposure point concentrations) that are used to evaluate potential risks associated with the site.

#### **4.1.10 OU 4-08: CFA-08 Sewage Plant (CFA-691), Septic Tank (CFA-716), Drainfield and CFA-49 Hot Laundry Drain Pipe**

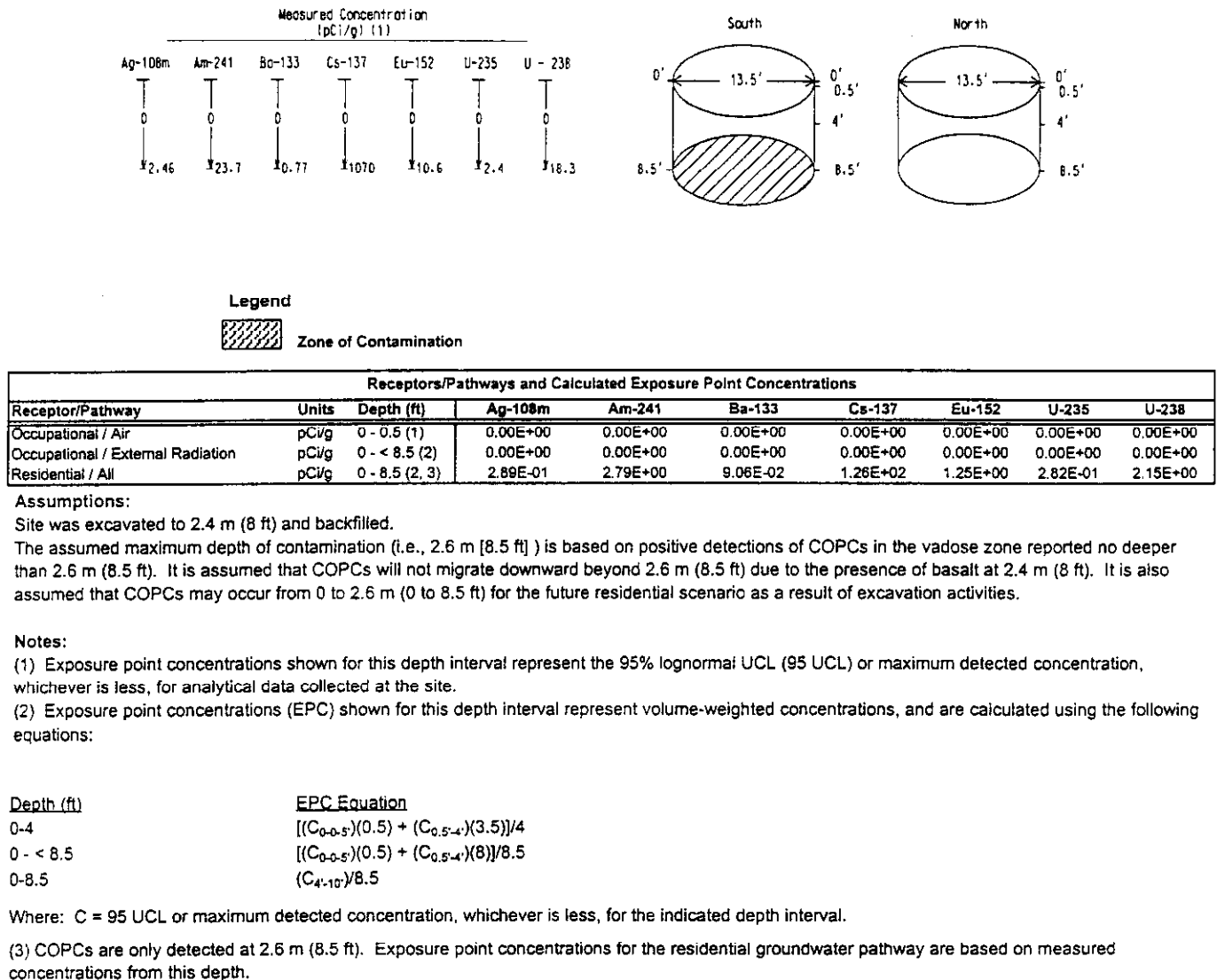
OU 4-08 consists of potential releases from the components of the Sewage Treatment Plant (STP), the septic tank, the pumping station, the drainfield, existing and abandoned lines from the pumping station to the drainfield, the abandoned sludge drying bed that was a part of the Navy sewer system at CFA, the perched water residue in sedimentary interbeds below and adjacent to the drainfield, and surface soils downwind of the CFA-08 sewer system and drainfield.

**4.1.10.1 Site Summary:** The CFA-08 drainfield is located approximately 450 m (1,476 ft) northeast of the STP (see Figure 4-16). The dimensions of the drainfield are 61 × 305 m (200 × 1,000 ft). It consists of five distribution areas (DAs), each with a distribution box and 20 distribution lines. The drainfield distribution lines are made of concrete drain tiles that lie approximately 1.0 m (3.5 ft) bgs. The first two drainfields were installed as part of the Navy's sewer system and were in operation since 1944. Two additional DAs were installed as part of the new sewer system in 1953, and a fifth DA was added in 1961 (EG&G 1988). Based on process knowledge, the CFA-08 drainfield received wastewater containing radiological and other effluent.

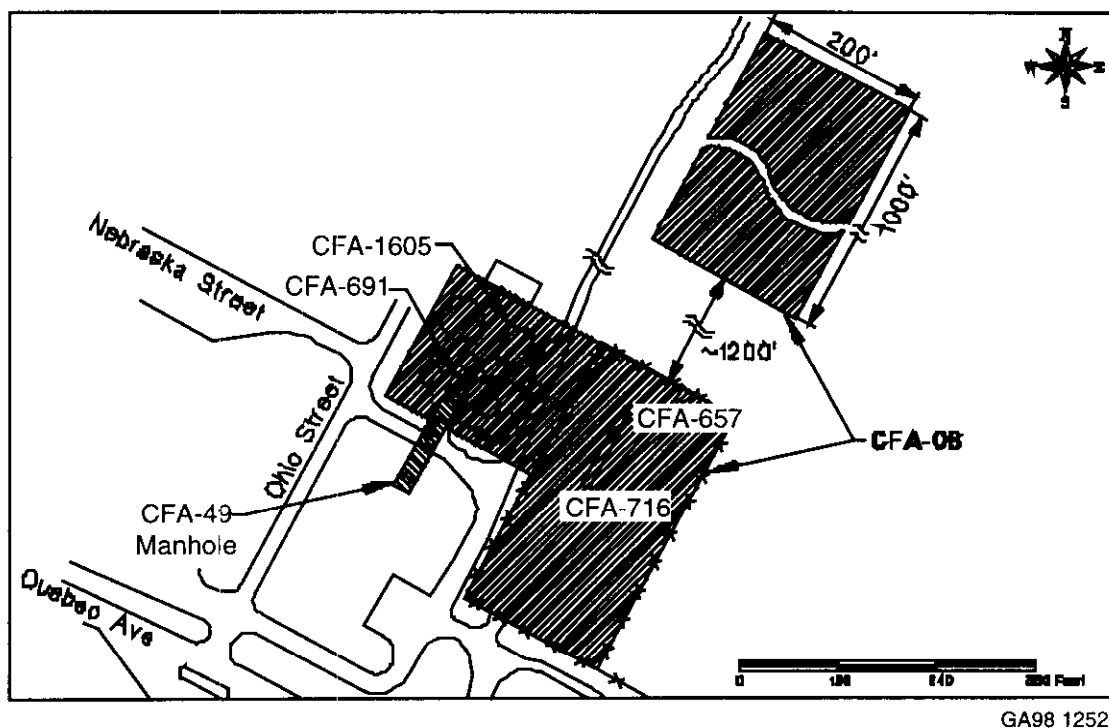
When the fifth DA was added to the drainfield in 1961, the original two 10-cm (4 in) pipelines between the pumping station and the drainfield were capped and abandoned in place. The pipelines were replaced with a new 20-cm (8-in) trunk line and feeder lines going to each of the distribution boxes and drainfield batteries. Two influent pipelines connect south of the STP, and a single influent line extends to the STP. To accommodate overflow, a pipeline ran from the adjoining influent lines to the CFA-716 septic tank (Evans, 1995).

The CFA-08 STP was used to treat and dispose of CFA process wastewaters from 1953 to 1995 (see Figure 4-16). The original system, installed by the Navy in 1944, handled wastewaters until 1953. The original Navy system was upgraded in 1953 to include a pump station, trickling filters, and a digester. The Navy plant is presumed to have handled only sanitary wastewater until 1950, when the original hot laundry was built. The hot laundry processed clothing contaminated with low-levels of radionuclides. The wastewater from this process was discharged directly from the plant. CFA-49 consists of an abandoned hot laundry drain pipe located at CFA-669 (Old Hot Laundry). The STP received effluent from the hot laundry via the laundry drain pipe until the drain pipe was abandoned in place 1980 (Stormberg et al. 1996). The STP was deactivated in 1995. The abandoned line from the hot laundry to the STP was removed during D&D of the hot laundry and was not evaluated as part of the OU 4-08 Track 2 investigation.

Perched water zones were created by the drainfield as were in existence as recently as 1995 when the drainfield was deactivated. The zones were investigated as part of the Track 2 investigation conducted in 1995. Two subsurface borings were completed to a depth of 31.3 m (102.7 ft) bgs on the



**Figure 4-15.** OU 4-07: CFA-12 nature and extent assumptions.



**Figure 4-16.** OU 4-08: CFA-08 Sewage Plant (CFA-691), Septic Tank (CFA-716), Drain Field, and CFA-49 Hot Laundry Drain Pipe.

east and west sides of the drainfield. The first saturated zone was located at a depth of 45.7 m (150 ft) bgs on the west side of the drainfield. The deeper zone was encountered at a depth of 31.3 m (102.7 ft). No perched water was encountered on the eastside. Five boreholes were also drilled within the drainfield to depths ranging from 5.8 m (19 ft) to 8.2 m (27 ft) bgs. Perched water was encountered at four of the five discharge areas. Water samples were collected from boreholes drilled into the zones where it was encountered.

Data from samples collected during the Track 2 Investigation indicate low concentrations of heavy metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver); however, none were above toxicity characteristic leaching procedure (TCLP) limits for the characteristic of toxicity (C. E. Klassy and A. F. Brown, D&D Characterization and Decision Analysis Report for the Central Facilities Area Sewage Treatment Plant, INEL-96/0360, Rev 0, June 1997). No TCLP VOCs or SVOCs were identified in the RCRA TCLP limits allowed in 40 Code of Federal Regulations (CFA) 261.24 for the toxicity characteristic. No TCLP VOCs or SVOCs were identified in any borehole samples. A hazardous waste determination (HWD), which used process knowledge and personnel interviews, determined that the waste materials did not qualify as RCRA Listed waste. Samples analysis detected only low levels of PCB contamination in the septic tank (CFA-716) and none in any of the borehole samples. The Toxic Substances Control Act (TSCA) regulatory limit for PCBs is 50 ppm; the highest PCB concentration of any sample in the septic tank was 4.2 ppm, and a HWD revealed that no solvents or PCB containing materials had access, or were intentionally disposed of or spilled to any sump, drain, etc., tied to the CFA STP. Therefore, the septic tank waste is not regulated by TSCA. Pesticide and herbicide contamination of the septic system was also below regulatory levels (Reference: M. D. Jorgensen, Environmental Affairs, Hazardous Waste Determination-CFA Sewage Treatment Plant Decontamination and Dismantlement, OU 4-13, "Sampling and Removal Action Activities," May 1, 1997).

**4.1.10.2 Previous Investigations:** The CFA-08 drainfield, abandoned Navy drying beds, perched water in sedimentary interbeds below and adjacent to the drainfield, and surface soils downwind of the CFA-08 sewer system and drainfield were evaluated in the OU 4-08 Track 2 investigation in 1994. Samples were collected from the drainfield as part of the OU 4-08 Track 2 investigation and were analyzed for radionuclides, metals, VOCs, SVOCs, PCBs, pesticides, and herbicides. Analytical results indicated radionuclides, metals, PCBs, VOCs, and SVOCs were present in the drainfield soils. Metals in the soil samples collected from the Navy drying bed were below background soil concentrations. Other tentatively identified compounds were detected in the analysis. The data for the unidentified compounds above 400 ug/kg were evaluated. The compounds identified in this evaluation include methyl isobutyl ketone, olefin and olefin isomers, alkyl esters of organic acids (compounds commonly found in various foods and fruits), 2,3,4-tribromophenol (surrogate compound used in laboratory analyses) and methyl acetate. Soil samples were analyzed for all of the contaminants detected in the perched water, except tritium. Chloromethane was the only VOC detected in perched water, after contaminant screening and was not detected in the soil. Perched water occurred in sedimentary interbeds below and adjacent to the drainfield. Chloromethane would typically be present in the wastewater and would readily escape as a gas when exposed to atmospheric conditions. In this case, it was captured in the perched water sample(s) but was not present in the soil due to its volatility. The metals detected on the perched water were arsenic, barium, lead, manganese and zinc. The concentrations of the trace metals arsenic and barium are below MCLs. There are no established background concentrations or MCLs for manganese and zinc. A radiological survey performed in 1994 indicated no surface soil contamination above background at areas downwind of the plant and drainfield.

Radionuclides detected in the perched-water samples include Am-241, Cs-137, Pu-238, Pu-239/240, Sr-90, tritium, U-234, and U-238. Sr-90 was detected in all samples above the MCL of 0.008 pCi/mL (8 pCi/L). The highest concentrations of Sr-90 were detected in the first two sampling rounds of DA 1 shallow well samples and had concentrations of 137 ( $\pm 2.0$ ) and 55 ( $\pm 1$ ) pCi/L. Total uranium (U-234, U-235, and U-238) MCLs are not available; however, the total uranium concentrations for OU 4-08 samples exceeded the background concentrations for total uranium. Tritium concentrations were below the MCLs in all samples. Pu-238, Pu-239/240, Cs-137, and Am-241 were detected only in shallow drainfield levels (18–29 ft). The MCLs for Am-241, Cs-137, Pu-238 and Pu-239/240 have not been established.

The results of the Track 2 investigation indicated that the abandoned Navy sludge drying beds could be eliminated from further evaluation because no chemicals of concern were identified following the data evaluation and screening. The investigation also concluded that the soils downwind of the STP and drainfield did not require further sampling and evaluation because the 1994 EM radiological survey indicated no surface soils were contaminated above background levels (Evans et al. 1995).

As discussed in the OU 4-13 RI/FS Work Plan, data gaps in the nature and extent of contamination from the drainfield and components of the STP exist (LMITCO 1997). The drainfield and STP (including the CFA-49 abandoned hot laundry drainpipe that discharge to the STP) are therefore retained for further evaluation in this BRA.

The CFA-08 drainfield, pipelines, and STP are evaluated as three separate CFA-08 sites in this RI/BRA because each of these CFA-08 components is located in a distinct area of CFA-08. Separation of CFA-08 into three sites also allows for a more site-specific delineation of the nature and extent of contamination at CFA-08; that is, COPCs are identified specifically for the drainfield, pipeline, and STP. This approach will enable any further action required for CFA-08 to be focused specifically on the drainfield, pipeline, or STP.

The following sections present the results of the supplemental contaminant screening for the CFA-08 drainfield, pipeline, and STP, and describe the nature and extent of contamination at each of these CFA-08 sites.

**4.1.10.3 CFA-08 Drainfield Nature and Extent of Contamination:** The initial contaminant screen presented in the RI/FS Work Plan identified Aroclor-1254, Aroclor-1260, arsenic, carbazole, isophorone, Am-241, Co-60, Cs-137, Eu-152, Eu-154, Pu-239/240, and U-235 as COPCs for CFA-08 and Co-60, Ra-226, and U-235 as COPCs for CFA-49. The COPCs identified in the Work Plan for CFA-08 were selected on a site-wide basis (i.e., COPCs were not selected separately for the drainfield, pipeline, and STP). The COPCs identified for CFA-08 in the Work Plan were assumed to be preliminary COPCs for the drainfield, pipeline, and the STP. Preliminary COPCs for the CFA-08 STP also assumed to include Ra-226, which was identified in the Work Plan as a COPC for CFA-49.

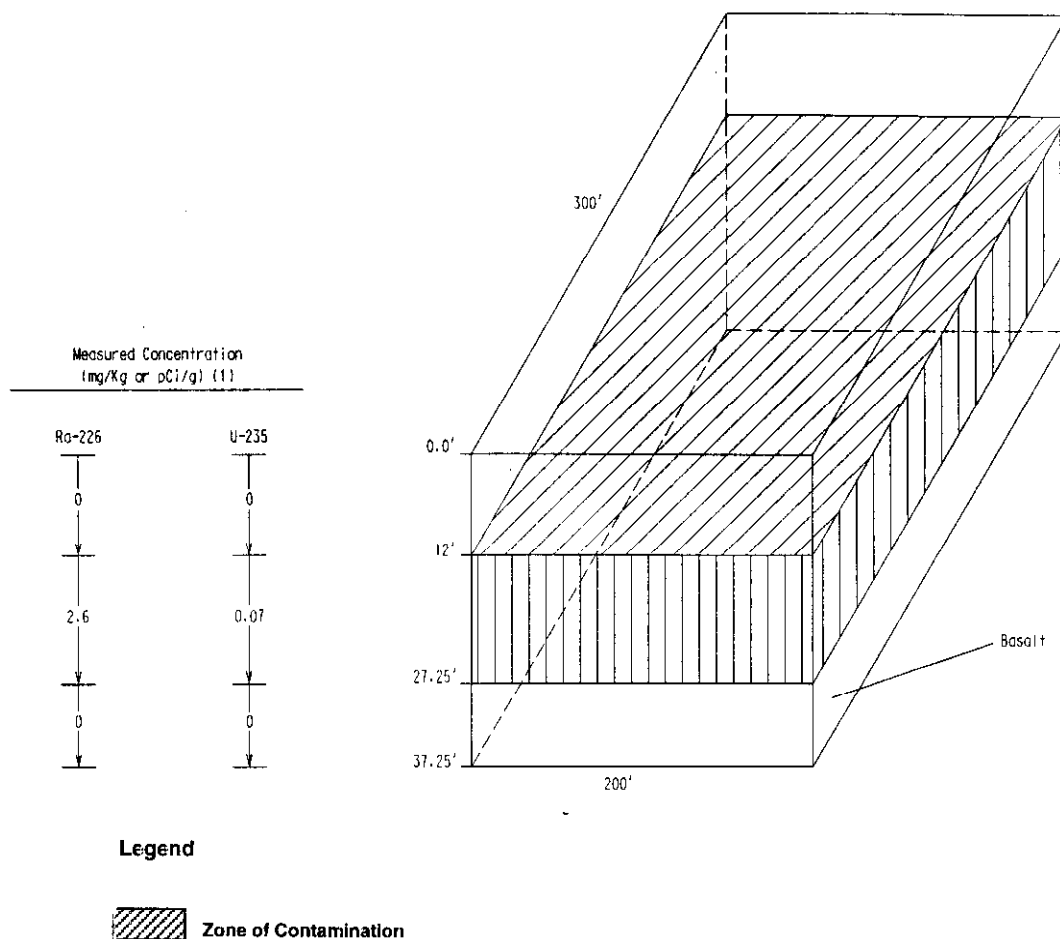
The results of the supplemental contaminant screen, presented in Table C-25, Appendix C, indicate Aroclor-1254, Cs-137, Pu-239/240, and U-235 are retained for further evaluation in the RI/BRA. Detected concentration of arsenic are not source related and are assumed to be within the range of background concentrations for INEEL soil. Arsenic is therefore eliminated as a COPC. Cs-137 was detected in 72.3 percent of 65 samples in concentrations ranging from 0.0795 to 180 pCi/g. Pu-239/240 was detected from 0.07 to 2.9 pCi/g, and U-235 from 0.031 to 0.44 pCi/g.

Data collected from 1994 to 1997 indicate that soils overlying the basalt are contaminated with Cs-137, Pu-239/240, and U-235. Although, actual basalt depths range from 6.1 to 9.9 m (20 to 32.4 ft), the assumed depth for the risk assessment is 9.9 m (32.4 ft). This assumption ensures that potential risks are not underestimated because the volume of contaminated soil is greater than actual.

The extent of contamination is assumed to encompass the entire drainfield (approximately 18,605 m<sup>2</sup> [22,252 yd<sup>2</sup>]). The volume of soil associated with the contamination at the CFA-08 drainfield is 184,189.5 m<sup>3</sup> (240,000 yd<sup>3</sup>) (Figure 4-17) (Evans et al. 1995). The summary statistics for the CFA-08 drainfield COPCs, are shown in Tables C-26 and C-27, Appendix C. Figure 4-17 shows the assumptions for the nature and extent of contamination, source-term estimates, and exposure point concentrations used to evaluate potential risks associated with the site.

**4.1.10.4 CFA-08 Pipeline Nature and Extent of Contamination:** The supplemental contaminant screen for the CFA-08 Pipeline, presented in Table C-28 of Appendix C, indicates that all of the Work Plan COPCs were eliminated from further evaluation in the BRA. Of the Work Plan COPCs, Aroclor-1254, Aroclor-1260, arsenic, Cs-137, and U-235 were all below screening levels; Am-241, Co-60, Eu-152, and Eu-154 were not detected; and carbazole, isophorone, and Pu-239/240 were not sampled. Detected concentrations of arsenic are not source related and are assumed to be within the range of background concentrations for INEEL soil. Arsenic is therefore eliminated as a COPC. Based on these results, the CFA-08 Pipeline is eliminated from further consideration in the BRA.

**4.1.10.5 Sewage Treatment Plant Nature and Extent of Contamination:** Under the D&D Program, subsurface soil samples were collected in the vicinity of the STP. Subsurface samples were analyzed for inorganics, metals, herbicides, PCBs, radionuclides, VOCs, and SVOCs. The results of the supplemental contaminant screen, (see Table C-30, Appendix C), indicate Ra-226 and U-235 are retained for further evaluation in the RI/BRA. Detected concentrations of arsenic are not source related and are assumed to be within the range of background concentrations for INEEL soil. Arsenic is therefore eliminated as a COPC. Ra-226 was detected in 100 percent of 13 samples and U-235 was detected in 73.1 percent of 26 samples. The range of detected concentrations of Ra-226 was 1.25 to 3.04 pCi/g; and U-235, 0.0195 to 0.232 pCi/g.



Receptors/Pathways and Calculated Exposure Point Concentrations				
Receptor/Pathway	Units	Depth (ft)	Ra-226	U-235
Occupational / Air	pCi/g	0 - 0.5 (1)	0.00E+00	0.00E+00
Occupational / External Radiation	pCi/g	0 - 4 (2)	0.00E+00	0.00E+00
Residential / Air	pCi/g	0 - 10 (2)	0.00E+00	0.00E+00
Residential / Groundwater	pCi/g	12 - 32.4 (2,3)	2.60E+00	1.52E-01

#### Assumptions:

The assumed maximum depth of contamination (i.e., 9.9 m [32.4 ft] ) is based on positive detections of COPCs in the vadose zone no deeper than 9.9 m (32.4 ft). It is assumed that COPCs will not migrate downward beyond 9.9 m (32.4 ft) due to the presence of basalt at 9.9 m (32.4 ft).

#### Notes:

(1) Exposure point concentrations shown for this depth interval represent the 95% lognormal UCL (95 UCL) or maximum detected concentration, whichever is less, for analytical data collected at the site.

(2) Exposure point concentrations (EPC) shown for this depth interval represent volume-weighted concentrations, and are calculated using the following equations:

Depth (ft)	EPC Equation
0-4	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5)]/4$
0-10	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6)]/10$
0-32.4	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6) + (C_{>10})(22.4)]/32.4$

Where: C = 95 UCL or maximum detected concentration, whichever is less, for the indicated depth interval.

**Figure 4-17. OU 4-08: CFA-08 Sewage Treatment Plant nature and extent assumptions.**

The primary structures at the treatment plant were constructed below the surrounding grade, approximately 3m (10 ft). In addition, some of the piping for the plant is below this level. Samples were collected in 1996 in the vicinity of the treatment plant at depths ranging from 3.7 to 8.3m (12 to 27.25 ft) to determine if leakage of effluent had occurred from the structures and piping which would have caused migration of potential contaminants from the plant. The analytical data from the samples indicate that soils overlying the basalt at a depth of 8.3m (27.25 ft) are contaminated with Ra-226, and U-235. Although, actual basalt depths range from 6.1 to 9.9m (20 to 32.4 ft), the assumed depth for the risk assessment is 9.9m (32.4 ft). This assumption ensures that potential risks are not underestimated because the volume of contaminated soil is greater than actual.

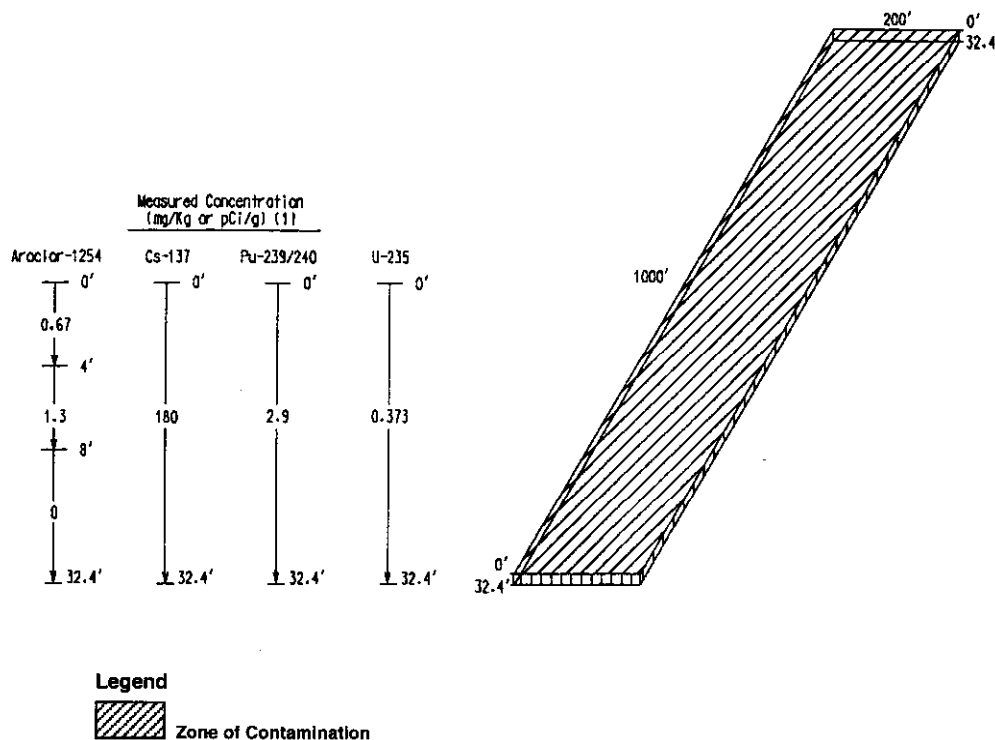
The extent of contamination is assumed to encompass the sewage treatment plant (approximately 5,566 m<sup>2</sup> [59,918 ft<sup>2</sup>]), although contaminants were not found near or outside the STP based on D&D sampling taken during the summer of 1997. This encompasses sample analytical results from a manhole adjacent to the sewage plant (CFA-49). The volume of soil associated with the contamination at the CFA-08 STP is 42,302 m<sup>3</sup> (56,034 yd<sup>3</sup>) (Figure 4-18) (Evans et al. 1995). The summary statistics for the CFA-08 STP COPCs, based on the contaminant screening process are shown in Tables C-30 and C-31, Appendix C. Figure 4-18 shows the assumptions for the nature and extent of contamination.

#### **4.1.11 OU 4-09: CFA-10 Transformer Yard Oil Spills**

**4.1.11.1 Site Summary.** CFA-10 is the site of possible PCB spills from storage of electrical transformers and of wastes disposed to the ground from welding shop operations. CFA-10 is a fenced yard area located adjacent to Building CFA-667, which was used as a welding shop from approximately 1958 to 1985 (see Figure 4-19). Waste from the welding shop may have included small amounts of solvents, along with chromium, cadmium, lead, zinc, and nickel. Process knowledge indicates that the CFA-10 yard was not used to routinely dispose waste, although some accidental spills of solid metals may have occurred. From 1985 to 1990, a 6.1 m (20 ft) wide by 20 m (65 ft) long concrete pad at the site was used as a temporary storage location for transformers, which may have contained PCBs, although there were no documented or suspect leaks or spills from the transformers (Gianotto et al. 1996).

**4.1.11.2 Previous Investigations.** A radiation survey performed at CFA-10 in 1991 detected no radiological activity in the surface soil. The Track 2 investigation focused on characterization of contamination caused by metals and PCBs (Gianotto et al. 1996). Six surface soil samples (0–0.15 m [0–0.5 ft] bgs) were collected for PCB analysis. All positive detections of PCBs were below 2 mg/kg, which is less than the Toxic Substances Control Act (TSCA) PCB screening concentration of 25 mg/kg for industrial sites. Four surface soil samples were collected for metals analysis (see Figure 3-2). Lead and arsenic were detected at levels above background concentrations. The Track 2 decision statement indicated that CFA-10 should be retained for further evaluation in the OU 4-13 RI/FS using the Track 2 investigation data. Data were collected in 1998 from 4 additional locations (see Figure 3-2) to determine the hazardous waste status of the soils using TCLP analysis. Samples were collected at four locations and analyzed for total lead and TCLP lead.

**4.1.11.3 Nature and Extent of Contamination.** An initial contaminant screening was performed in the OU 4-13 Work Plan using the Track 2 data. This screen identified the following contaminants as COPCs: arsenic, lead, Aroclor-1254, and Aroclor-1260. The results of the supplemental contaminant screen conducted as part of this RI/BRA (Table C-33, Appendix C) indicate lead, Aroclor-1254, and Aroclor-1260 are retained as COPCs for further evaluation in the BRA. Detected concentrations of arsenic are not source related and are assumed to be within the range of background concentrations for INEEL soils. Arsenic is therefore eliminated as a COPC. The other contaminants were eliminated from further evaluation.



Receptors/Pathways and Calculated Exposure Point Concentrations						
Receptor/Pathway	Units	Depth (ft)	Cs-137	Pu-239/240	U-235	Aroclor-1254
Occupational / Air	mg/Kg or pCi/g	0 - 0.5 (1)	1.69E+02	2.90E+00	2.21E-01	6.70E-01
Occupational / External Radiation	mg/Kg or pCi/g	0 - 4 (2)	1.79E+02	4.24E-01	3.44E-01	6.70E-01
Residential / All	mg/Kg or pCi/g	0 - 10 (2)	8.89E+01	1.70E-01	2.22E-01	7.88E-01
Residential / Groundwater	mg/Kg or pCi/g	0 - 32.4 (2)	2.74E+01	5.23E-02	1.49E-01	2.43E-01

#### Assumptions:

The assumed maximum depth of contamination (i.e., 9.9 m [32.4 ft] ) is based on the conservative assumption that downward migration of contamination has contaminated the soil column from the maximum sampling depth at 8.3 m (27.25 ft) down to the basalt interface.

#### Notes:

(1) Exposure point concentrations shown for this depth interval represent the 95% lognormal UCL (95 UCL) or maximum detected concentration, whichever is less, for analytical data collected at the site.

(2) Exposure point concentrations (EPC) shown for this depth interval represent volume-weighted concentrations, and are calculated using the following equations:

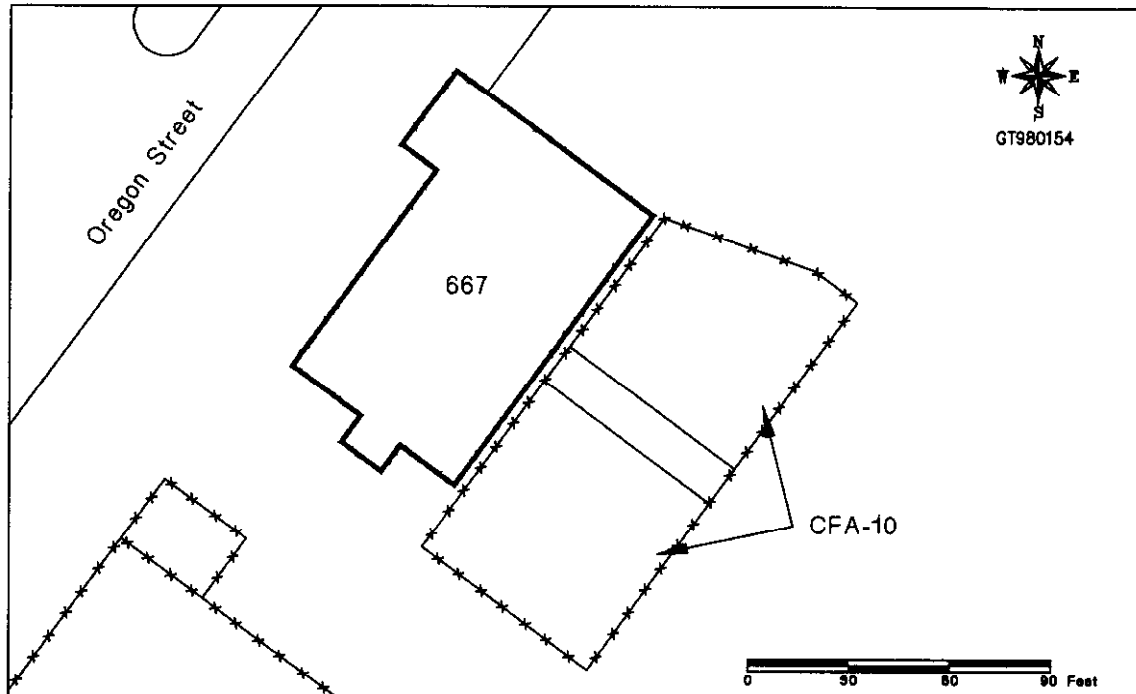
Depth (ft)	EPC Equation
0-4	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5)]/4$
0-10	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6)]/10$
0-32.4	$C_{>10'}$

Where: C = 95 UCL or maximum detected concentration, whichever is less, for the indicated depth interval.

(3) COPCs are only detected from 3.7 to 8.3 m (12 to 27.25 ft) bgs. Exposure point concentrations for the residential groundwater pathway are based on measured concentrations from this depth interval.

**Figure 4-18.** OU 4-08: CFA-08 Drainfield nature and extent assumptions.





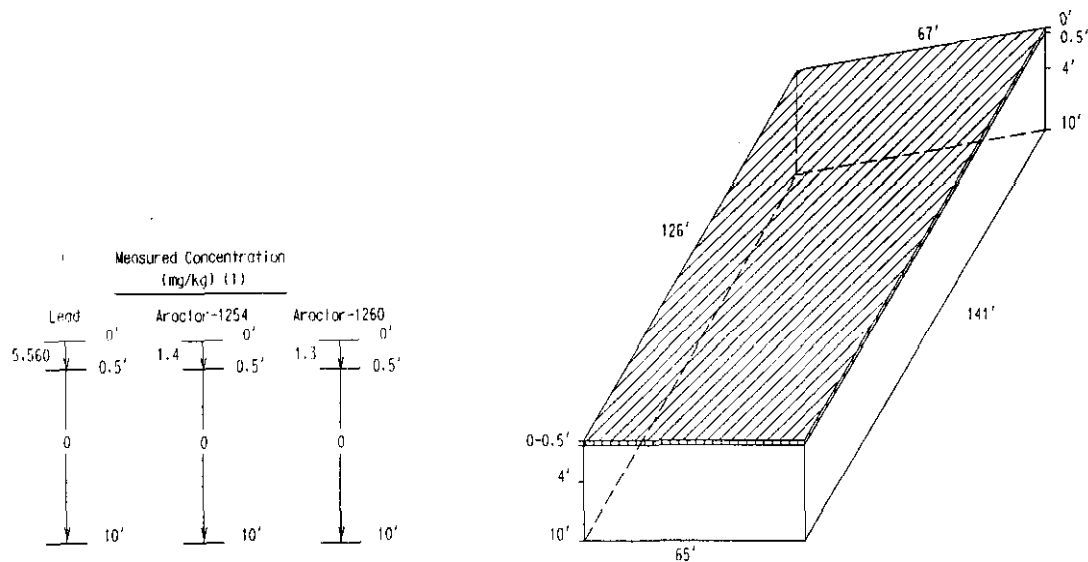
**Figure 4-19.** OU 4-09: CFA-10 Transformer Yard Oil Spills.

Analytical data collected during 1997 and 1998 (a total of 8 locations) indicate that the surface soils to 0–0.15 m (0–0.5 ft) bgs at CFA-10 are contaminated lead (see Tables C-34 and C-35, Appendix C) in concentrations ranging from 16.5 to 5,560 mg/kg. The full extent of contamination is possibly greater than just these locations because no specific pattern of welding activities or waste disposal of scrap lead in the yard could be identified. For risk assessment purposes, a depth of 0 to 3.05 m (0–10 ft) bgs is assumed for evaluation of residential exposure pathways. Therefore, it is assumed that the full area of the yard (808 m<sup>2</sup> [966 yd<sup>2</sup>]) (Figure 4-20) is contaminated to a depth of approximately 3.05 m (10 ft). The depth of contamination is assumed to be limited to the soil surface (less than or equal to 0.15 m (0.5 ft). Downward migration is not assumed to occur based on previous removal actions at OU 4-06, for which the depth of contaminant migration was shown to be limited to the surface soil, where contaminated soil was removed. The source-term volume is 2,463 m<sup>3</sup> (3,222 yd<sup>3</sup>) of lead-contaminated soil, based on the above assumption (see Figure 4-20).

#### 4.1.12 OU 4-09: CFA-26 CFA 760 Pump Station Fuel Spill

**4.1.12.1 Site Summary.** CFA-26 is the site of a 209,700-L (55,400-gal) potential loss of diesel fuel. The 227,600 L (55,000 gal) above-ground storage tank was constructed in 1950 and removed in 1986. The loss of fuel occurred over the period from January to March 1979 and was discovered as a result of tank gauging measurements. The heating system was designed to circulate the fuel oil in the tank through the manifold to keep it warm during the winter. The sump consisted of a square concrete-walled structure approximately 6' × 6' in size with the top of the sump at the ground surface. The floor of the sump, located 1.2 m (4 ft) bgs, was open to the soil/gravel. The heating manifold was accessed through a manhole cover at the ground surface.

The cause of the leak was determined to be a small hole in a steam heating manifold, which was located in a piping sump adjacent to the tank. The leak would have discharged directly to the subsurface soils via the gravel bottom of the sump [1.2 m (4 ft) bgs], over a 3-month period, which would have required a minimum discharge rate of 0.4275 gallons/minute.



#### Legend

 Zone of Contamination

Receptors/Pathways and Calculated Exposure Point Concentrations					
Receptor/Pathway	Units	Depth (ft)	Lead	Aroclor-1254	Aroclor-1260
Occupational / Air	mg/kg	0 - 0.5 (1)	3.30E+03	1.40E+00	1.30E+00
Occupational / External Radiation	mg/kg	0 - 4 (2)	4.13E+02	1.75E-01	1.63E-01
Residential / Air	mg/kg	0 - 10 (2)	1.65E+02	7.00E-02	6.50E-02

#### Assumptions:

The area of contamination is the area of the site based on process knowledge that there was no specific pattern of waste disposal. The maximum depth of contamination is 0.15 m (0.5 ft) bgs based on analytical data. For purposes of evaluating the future residential scenario, it is assumed that contamination may occur to a depth of 3.05 m (10 ft) bgs as a result of excavation activities.

#### Notes:

(1) Exposure point concentrations shown for this depth interval represent the 95% lognormal UCL (95 UCL) or maximum detected concentration, whichever is less, for analytical data collected at the site.

(2) Exposure point concentrations (EPC) shown for this depth interval represent volume-weighted concentrations, and are calculated using the following equations:

Depth (ft)	EPC Equation
0-4	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5)]/4$
0-10	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6)]/10$

Where: C = 95 UCL or maximum detected concentration, whichever is less, for the indicated depth interval.

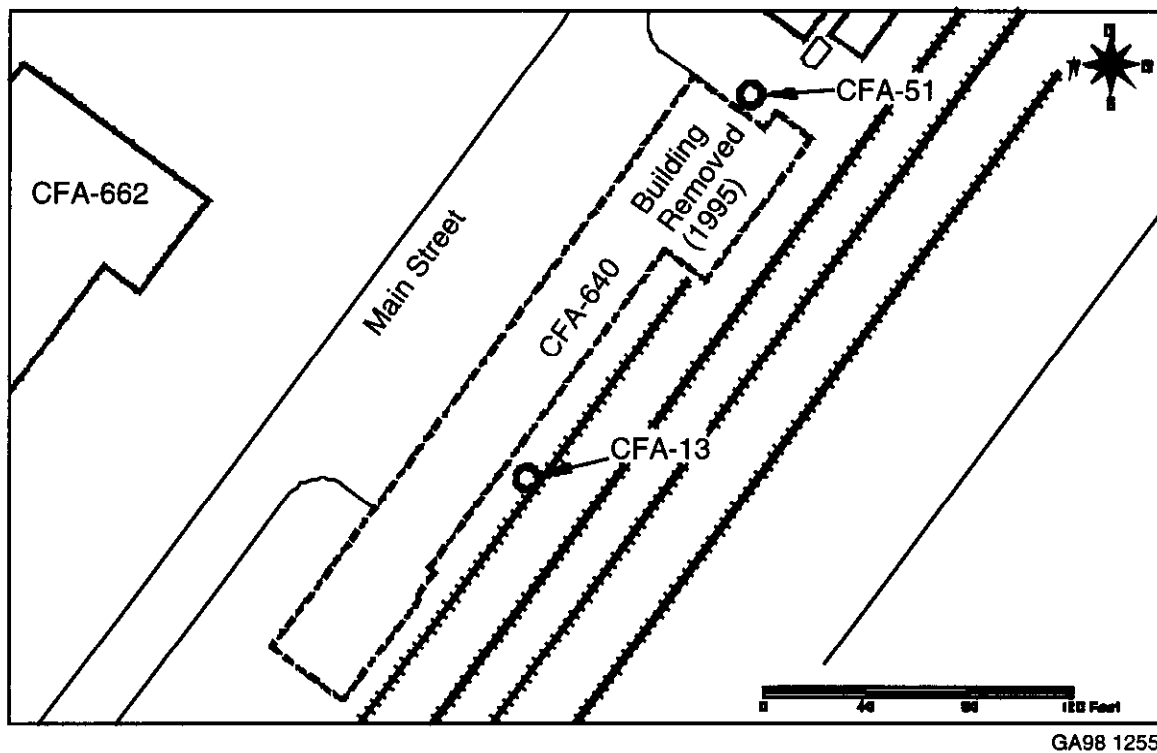
**Figure 4-20.** OU 4-09: CFA-10 nature and extent assumptions.

Integrity tests performed on the tank after the incident revealed that the tank was not the source of leakage. The location of the former tank is now occupied by building CFA-623, the Multicrafts Shop (see Figure 4-21). Interviews with personnel who worked on the foundation construction revealed that diesel fuel odor or stained soil was not noticed during the construction period. The above information indicates that the discharge occurred primarily to the subsurface soil.

**4.1.12.2 Previous Investigations.** A Track 2 investigation was performed at CFA-26 in 1995. The information in Section 4.1.12.2 was gathered during the investigation and prior to field data collection. As a result, subsurface samples were collected from five boreholes at the soil-basalt interface in the vicinity of the former tank. The boreholes were placed as close to the former tank location as possible, however the presence of CFA-623 interfered with borehole placement directly over the former tank or sump location. The depth to basalt, based on these boreholes, ranges from 2.9 to 3.4 m (9.5 to 11.2 ft).

Samples collected from the boreholes were analyzed for VOCs, SVOCs, and TPH. Four of the five samples contained TPH at concentrations below the INEEL screening level of 1,000 mg/kg. The TPH concentration in the fifth borehole was 3,470 mg/kg at a depth of 3.4 m (11.2 ft). Three other contaminants were detected, chlorodifluoromethane (0.1 mg/kg), phenol (0.31 mg/kg), and di-n-butylphthalate (0.49 mg/kg), which were screened from further evaluation in the Work Plan.

**4.1.12.3 Nature and Extent of Contamination.** Data collected during the Track 2 investigation indicate that surface soils to a depth of 3 m (10 ft) are not contaminated and that TPH contamination was detected in the soil at approximately 3 to 4.4 m (10 to 11.2 ft). All contaminants at CFA-26 were eliminated in the contaminant screen in the Work Plan, therefore eliminating a supplemental contaminant screen. However, the potential exists for petroleum contamination in the basalt, consequently, the groundwater exposure pathway to assess cumulative risk to groundwater is evaluated in Section 6.



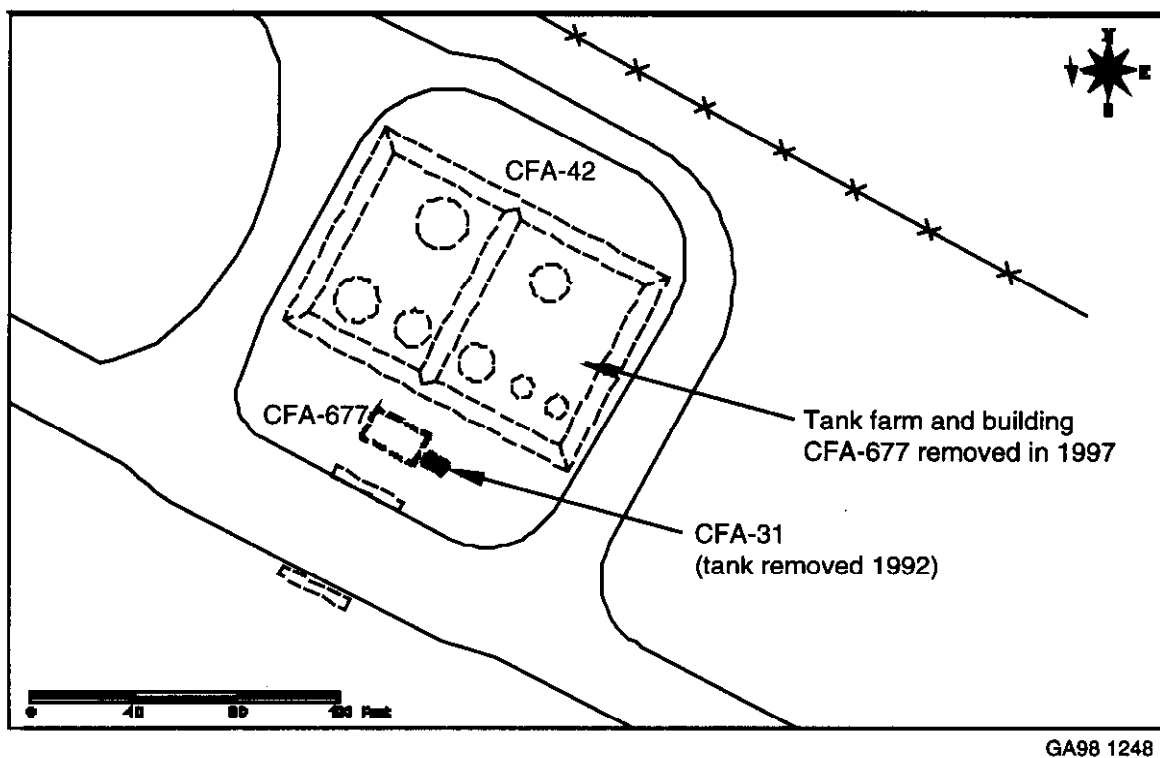
**Figure 4-21.** OU 4-09: CFA-26 CFA-760 Pump Station Fuel Spill.

borehole, 3.4 m (11.2 ft) bgs is 3,470 mg/kg. Three other contaminants, chlorodifluoromethane (0.1 mg/kg), phenol (0.31 mg/kg), and di-n-butylphthalate (0.49 mg/kg), were detected at low concentrations. However, these were screened from further evaluation in the Work Plan.

#### 4.1.13 OU 4-09: CFA-42 Tank Farm Pump Station Spills

**4.1.13.1 Site Summary.** CFA-42 consists of the area around and beneath the Tank Farm where spills and leaks of unused fuel occurred. The CFA Tank Farm area was constructed in 1950 and deactivated in 1994 (Landis et. al., 1998). It was used for bulk storage of diesel fuel, gasoline, kerosene, and white gas. Two catch basins, located on the south side of Quebec Avenue, were used to receive fuel from bulk tanker trucks to the tanks. The fuel rack, located on the north side of Quebec Avenue, was used for delivery of fuel to fuel trucks that supplied INEEL facilities (see Figure 4-22). Visible soil staining, especially around the catch basins, was the result of occasional small spills of unused fuel during delivery operations. All contaminated soil, piping, tanks, and structures were removed during two removal actions, discussed below.

**4.1.13.2 Previous Investigations.** A Track 2 investigation was conducted in 1995 to determine the extent of contamination in the vicinity of the catch basins and the fuel rack. Excavation around the catch basins indicated the presence of petroleum odors and discoloration. It was concluded that the extent of petroleum contamination was greater than originally estimated. Soil samples were collected from contaminated areas, and the excavation was backfilled. Analytical results from the soil samples collected from the excavation indicate detectable levels of 2-methylnaphthalene, acenaphthene, pyrene, and TPH. The Track 2 risk assessment indicated that the HQ exceeded 1.



**Figure 4-22.** OU 4-09: CFA-42 Tank Farm Pump Station Spills.

A time-critical removal action was conducted in June 1996 to remove petroleum-contamination on the west side of Quebec Avenue to concentrations below 1,000 mg/kg (Landis et. al., 1998). The catch basins and associated piping were removed along with 1,797 m<sup>3</sup> (2,350 yd<sup>3</sup>) of contaminated soil down to the top of basalt, approximately 7.6 m (25 ft) bgs. The soil was treated at the INEEL Landfarm.

Verification samples were collected from the face and bottom of the excavation. Data indicated that TPH contamination was less than 1,000 mg/kg. While the removal action accomplished the goal to remove TPH contaminated soil to below 1,000 mg/kg the full extent of contamination beneath the Tank Farm was not determined. The possibility existed that TPH contamination could be present beneath the north fuel rack and the bulk fuel tanks at concentrations greater than 1,000 mg/kg.

Based on a review of the Track 2 and removal action information, the extent of contamination was considered a data gap. This site was therefore retained for further evaluation in the OU 4-13 RI/BRA.

Prior to any demolition activities at CFA-42, it was necessary to perform both lead analysis and asbestos analysis on the pump house and the fuel tanks. Lead paint was found to be present on the tanks and above-ground piping. This material was disposed of in the CFA Landfill.

Demolition activities began July 29, 1997 with removal of pumps and piping in and around the pump house and fill station. This also meant draining the fuel systems prior to any demolition efforts. The residual fuels were stored in 208 L (55 gal) drums prior to disposal. There were 5 total drums, one each for the following: unleaded gasoline, fuel oil, diesel #1, diesel #2, and mixed diesel #1 and #2. The residual fuel was placed in a UST used for petroleum product storage. This UST was used as a fuel source for the boiler at CFA. After the pumps and associated piping were removed from CFA-42, the pump house and fill station were demolished and taken to the CFA Bulky Waste Landfill for disposal. After the pump house and piping were removed, the demolition of tanks began. The tanks were cut up and taken to CFA warehouse for recycling.

Excavation activities began on August 18, 1997. Because the soil was dark gray and moist in appearance with a strong petroleum odor, the excavation followed visual and odor observations, as well as PID readings. The excavated soil was loaded into dump trucks, weighed, and transported to the CFA Landfarm for treatment. The total amount of contaminated soil removed from the area was 4,921 m<sup>3</sup> (6,437 yd<sup>3</sup>).

As excavation continued, the contamination was observed to extend horizontally in all directions from the fill station area. Consequently, a section of Quebec Avenue was removed. Soil with low PID readings was stockpiled south and east of the excavation on a tarp to be used as backfill. Additional backfill material was obtained from the CFA gravel pit. Soil used for topsoil was obtained from the Spreading Area "B."

Confirmation samples were collected prior to backfilling this excavation. These samples are used to evaluate the current nature and extent of contamination at CFA-42. The initial contaminant screen presented in the RI/FS Work Plan identified 2-methylnaphthalene and phenanthrene as COPCs at CFA-42. The results of the supplemental contaminant screen, presented in Table C-36, Appendix C, indicate that phenanthrene should be retained for further evaluation in the RI/BRA. Phenanthrene was detected in 4.8 percent of 42 samples (0.00428 and 0.0157 mg/kg) at 20 ft bgs, which is in the basalt.

Post removal action samples did not include 2-methylnaphthalene. There is a high likelihood that the 2-methylnaphthalene contamination was removed along with the site's other contaminants, but removal of all of the 2-methylnaphthalene contamination was not confirmed by the post-removal action

sampling. The potential impacts of contamination that was not detected by sampling are discussed in Section 6.5.

**4.1.13.3 Nature and Extent of Contamination.** Measured concentrations indicate that subsurface soils (6.1 m [20 ft] bgs) at CFA-42 are contaminated with low levels of phenanthrene. During the 1997 removal action, basalt was encountered at depth ranging from 6.1 to 7.3 m (20 to 24 ft) bgs. Because soils at CFA-42 have been remediated to the surface of basalt and the area backfilled with clean soil from the Quebec Avenue excavation and the CFA gravel pit, the residual contamination is assumed to occur in the basalt.

The extent of the contamination is assumed to encompass the entire site (approximately 83.6 m<sup>2</sup> [100 yd<sup>2</sup>]). For purposes of assessing cumulative risk to groundwater, the thickness of contamination is assumed to be 0.15 m (0.5 ft) deep beneath the backfill. Therefore, the volume of soil associated with the contamination at CFA-42 is 12.54 m<sup>3</sup> (450 ft<sup>3</sup>) (Figure 4-23) (Gianotto et al. 1996). The summary statistics for phenanthrene are shown in Tables C-37 and C-38, Appendix C. Figure 4-23 shows the assumptions for the nature and extent of contamination and source-term estimates (i.e., exposure point concentrations) that are used to evaluate potential risks associated with the site. Evaluation of potential risks from phenanthrene will be limited to residential groundwater exposure pathways because phenanthrene-contaminated soil occurs at depths greater than 3.6 m (12 ft) bgs.

#### **4.1.14 OU 4-09: CFA-46 Cafeteria Oil Tank Spill (CFA-721)**

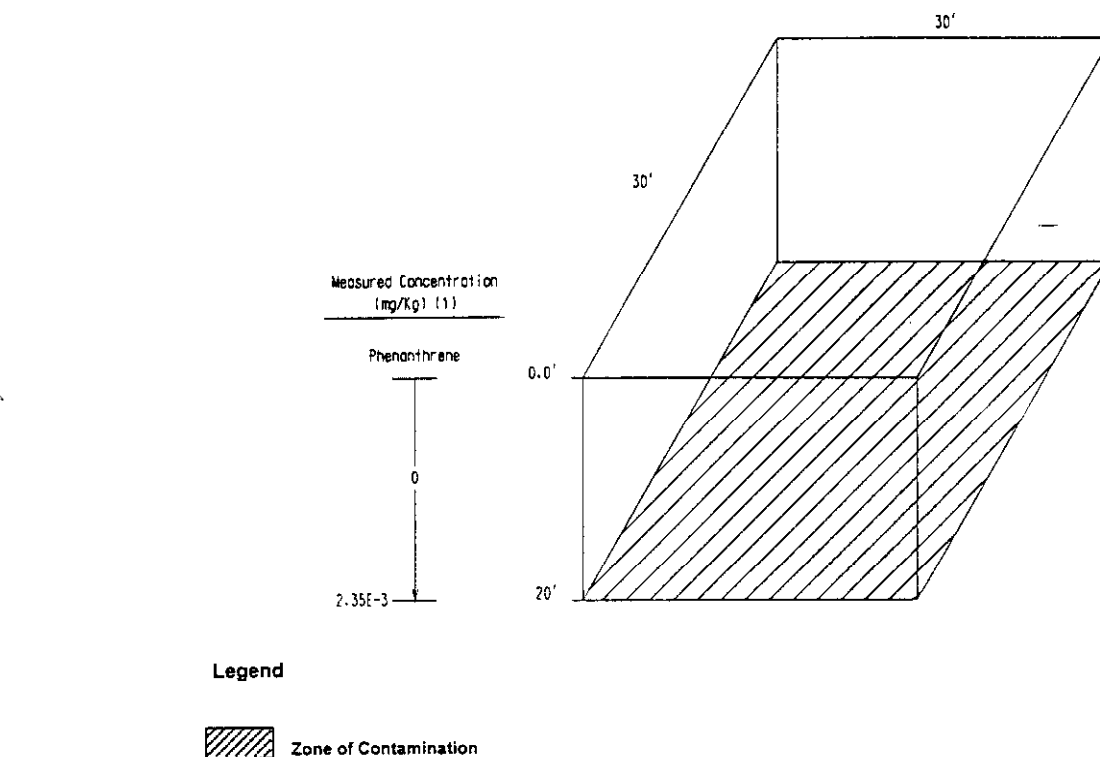
**4.1.14.1 Site Summary.** CFA-46 is the site of a diesel fuel leak from an 18,927-L (5,000-gal) underground fuel storage tank (CFA-721) (Figure 4-24). The tank was installed in 1963 and removed in September 1994. The tank, associated piping, and an estimated 229 m<sup>3</sup> (300 yd<sup>3</sup>) of contaminated soil were removed during excavation. The excavation extended to basalt, which was encountered at 4.9 m (16 ft) bgs. The contaminated soil was treated at the CFA landfarm and the piping was disposed at the CFA Landfill. The basalt appears to be contaminated but has not been sampled; consequently, the concentrations and volume of COPCs are not known (Gianotto et al. 1996).

**4.1.14.2 Previous Investigations.** Data and other information presented in this section are from the tank removal operation. Two soil samples were collected from the bottom of the excavation (4.9 m [16 ft] bgs) and analyzed for TPH. Seven additional soil samples were collected from six locations at the site, before the excavation was backfilled. Analysis was performed for benzene, toluene, ethylbenzene, and xylenes (BTEX). The contaminant screen presented in the RI/FS Work Plan initially identified BTEX and diesel-range TPH (TPHd) as COPCs.

**4.1.14.3 Nature and Extent of Contamination.** The supplemental contaminant screen for CFA-46, presented in Table C-39, Appendix C, indicates that the levels of BTEX and TPH, identified in the Work Plan as COPCs, are below screening levels (see Table C-40 for summary statistics). However, because the depth of contamination at CFA-46 is greater than 3 m (10 ft), the site is retained for evaluation of cumulative risk associated with the groundwater pathway.

#### **4.1.15 OU 4-11: CFA-05, Motor Pool Pond**

**4.1.15.1 Site Summary.** The CFA-05 Motor Pool Pond consists of an unlined evaporation pond located in an abandoned borrow pit approximately 3,656 (12,000 ft) east of the CFA Equipment Storage Yard (see Figure 4-25). The site includes the sediments of the pond, sediments along the inlet ditch, and at the discharge pipe. The pond received wastes from the wash bay and outside sumps at the Service.



Receptors/Pathways and Calculated Exposure Point Concentrations			
Receptor/Pathway	Units	Depth (ft)	Phenanthrene
Occupational / Air	mg/kg	0 - 0.5 (1)	0.00E+00
Occupational / External Radiation	mg/kg	0 - 4 (2)	0.00E+00
Residential / All	mg/kg	0 - 10 (2)	0.00E+00
Residential / Groundwater	mg/kg	20 (3)	2.66E-03

#### Assumptions:

Site was excavated to 7.3 m (24 ft) and backfilled, but positive chemical detections are reported at 6.1 m (20 ft). The assumed maximum depth of contamination (i.e., 6.1 m [20 ft]) is based on positive detections of COPCs in the vadose zone no deeper than 6.1 m (20 ft). It is assumed that COPCs will not migrate downward beyond 6.41 m (20 ft) due to the presence of basalt at 6.1 m (20 ft).

#### Notes:

(1) Exposure point concentrations shown for this depth interval represent the 95% lognormal UCL (95 UCL) or maximum detected concentration, whichever is less, for analytical data collected at the site.

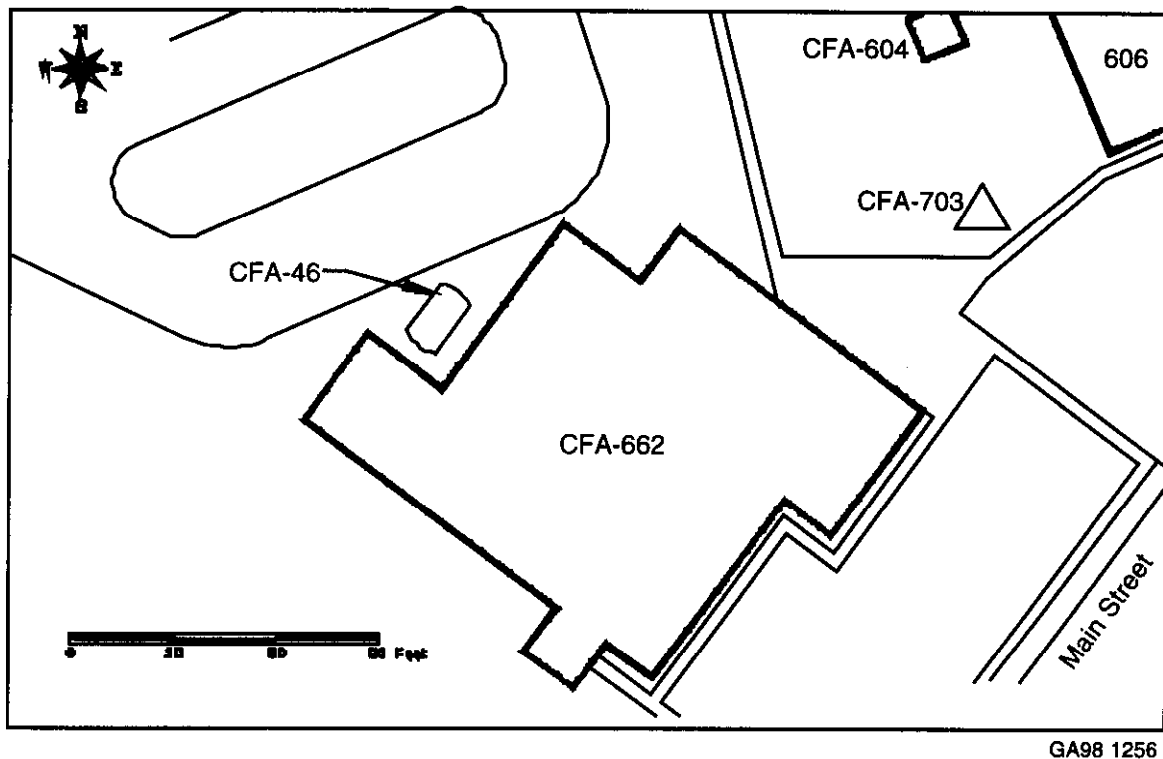
(2) Exposure point concentrations (EPC) shown for this depth interval represent volume-weighted concentrations, and are calculated using the following equations:

Depth (ft)	EPC Equation
0-4	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5)]/4$
0-10	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6)]/10$
20	$C_{>10'}$

Where: C = 95 UCL or maximum detected concentration, whichever is less, for the indicated depth interval.

(3) COPCs are only detected at 6.1 m (20 ft) bgs. Therefore, exposure point concentrations for the residential groundwater pathway are based on measured concentrations at 6.1 m (20 ft) bgs.

**Figure 4-23.** OU 4-09: CFA-42 nature and extent assumptions.

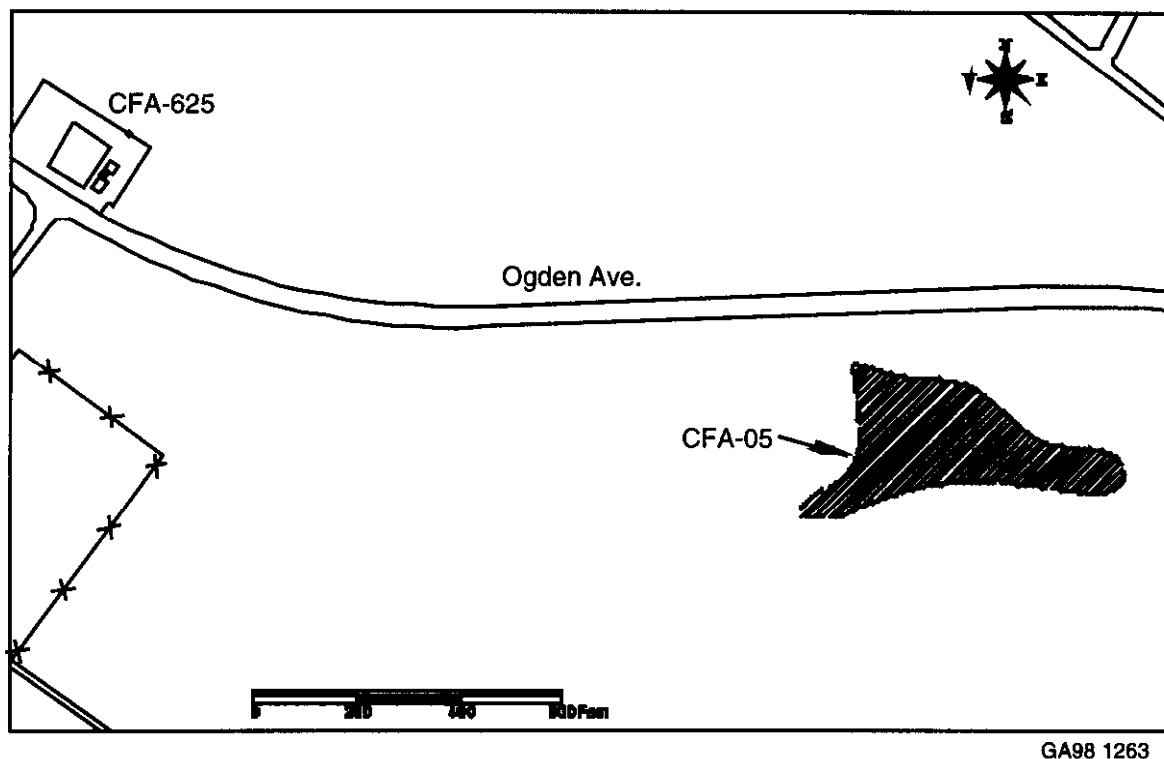


**Figure 4-24.** OU 4-09: CFA-46 Cafeteria Oil Tank Spill (CFA-721).

**4.1.15.2 Previous Investigations.** The CFA Motor Pool Pond (OU 4-11) was investigated in 1989 to support a RCRA closure plan. These data were later evaluated in the OU 4-11 RI/FS (Spry et al. 1992) and were the basis of a Record of Decision (DOE 1992). The scope of the RI was limited to surface sediments and did not include characterization of the subsurface geology or groundwater. As stated in Section 1.1 of the OU 4-11 RI/FS, “the potential for groundwater contamination as a result of past waste disposal practices, and the potential for exposures to contaminated groundwater, would be evaluated in a future investigation.” The investigation consisted of collection of 41 soil samples from sediments in the pond and along the inlet ditch. Thirty-eight of the samples were analyzed for gamma-emitting radionuclides and three for alpha-emitting radionuclides. Four of the samples were analyzed for metals and VOCs.

**4.1.15.3 Nature and Extent of Contamination.** Analytical data from the investigation indicate that metals are present in the sediments above background concentrations. These include barium; 92.4 to 434, beryllium; 0.22 to 1.4 mg/kg, cadmium; 0.53 to 38.8 mg/kg, chromium; 8.2 to 91.3 mg/kg, lead; 10.6 to 631 mg/kg, mercury; 0.06 to 1.2 mg/kg, and thallium; 0.3 to 1.0. The highest concentrations of metals were found in the sediments along the ditch from 0 to 2 m (0 to 7 ft) in depth, and in sediments along the ditch. The VOC data indicate that four compounds (acetone - 90 ug/kg, 2-butanone - 40 ug/kg, 4-methyl 2-pentanone - 40 ug/kg, methylene chloride - 40 ug/kg, and tetrachloroethylene - 76 ug/kg) were detected at a depth of 4 m (13 ft) in the pond sediments. Aroclor-1260 was detected in sediments near the outlet pipe at a concentration of 1,470 ug/kg. Radionuclides (Am-241 - 2.72 pCi/g, Cs-137 - 8.4 pCi/g, and Pu-239 - 4.29 pCi/g) were detected in surface sediments of the ditch and pond. The OU 4-11 BRA for the site indicates that the potential risks to human health are within the acceptable risk range for future residential exposure pathways and consequently, the ROD documents a “no further action decision.”





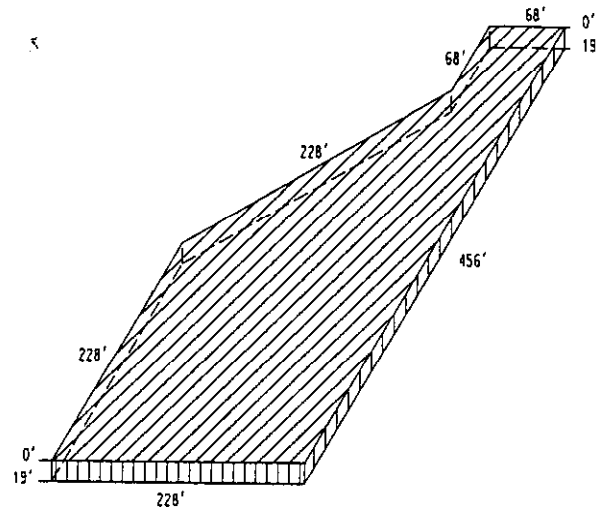
**Figure 4-25.** OU 4-11: CFA-05 Motor Pool Pond.

These data from the investigation were evaluated in a supplemental contaminant screen to determine the groundwater COPCs for the groundwater exposure pathway. The results of the screen are presented in Table C-41 of Appendix C. The summary statistics for COPCs are shown in Tables C-42 and C-43, Appendix C. The COPCs retained for the groundwater risk evaluation are: Aroclor-1260, Ac-228, Am-241, arsenic, Bi-212, Bi-214, Cs-137, lead, Pb-212, Ra-226, and Tl-208. Figure 4-26 shows the source term estimates used to evaluate risk associated with the groundwater pathway in Section 6 of this BRA.

#### **4.1.16 OU 4-13: CFA-51 Dry Well at North End of CFA-640**

**4.1.16.1 Site Summary.** This site is a former small dry well located at the north end of Building CFA-640 (see Figure 4-27). The dry well was discovered on December 13, 1995 during excavation of the building's water lines as part of CFA-640 D&D Program activities. The site was added to the FFA/CO due to the potential release of contaminants.

The dry well was constructed from a short section of clay sewer pipe set vertically in the ground. The pipe was approximately 0.46 m (1.5) ft in diameter, 0.61 to 0.91 m (2 to 3 ft) in length, with a round steel cover at the ground surface. A smaller buried pipe connected the dry well to CFA-640. The source of potential contamination within CFA-640 was a floor drain in the building, which served a garage area for vehicle repair and parking. The floor drain was covered when the garage was modified for other uses.



**Legend**  
 **Zone of Contamination**

Receptors/Pathways and Calculated Exposure Point Concentrations				
Receptor/Pathway	Units	Depth (ft)	Lead	Aroclor-1254
Occupational / Air	mg/kg	0 - 0.5 (1)	2.61E+02	1.01E+00
Occupational / External Radiation	mg/kg	0 - 4 (2)	1.61E+02	3.36E-01
Residential / All	mg/kg	0 - 10 (2)	1.07E+02	1.34E-01
Residential / Groundwater	mg/kg	0 - 19 (2)	6.37E+01	7.07E-02

Receptors/Pathways and Calculated Exposure Point Concentrations										
Receptor/Pathway	Units	Depth (ft)	Ac-228	Am-241	Bi-212	Bi-214	Cs-137	Pb-212	Ra-226	Tl-208
Occupational / Air	pCi/g	0 - 0.5 (1)	1.31E+00	9.46E+00	1.46E+00	1.27E+00	8.41E+00	1.36E+00	2.93E+00	1.29E+00
Occupational / External Radiation	pCi/g	0 - 4 (2)	1.32E+00	2.31E+00	1.53E+00	1.24E+00	2.50E+00	1.31E+00	2.66E+00	1.27E+00
Residential / All	pCi/g	0 - 10 (2)	1.37E+00	9.25E-01	1.17E+00	1.09E+00	1.00E+00	1.42E+00	2.35E+00	1.27E+00
Res (3) - Groundwater	pCi/g	0 - 12	1.37E+00	9.25E-01	1.17E+00	1.09E+00	9.76E-01	1.42E+00	2.35E+00	1.27E+00
Residential / Groundwater	pCi/g	0 - 19 (2)	1.21E+00	4.87E-01	1.18E+00	9.76E-01	5.27E-01	1.24E+00	2.00E+00	1.13E+00

**Assumptions:**

The assumed maximum depth of contamination (i.e., 5.8 m [19 ft]) is based on positive detections of COPCs in the vadose zone no deeper than 5.8 m (19 ft). It is assumed that COPCs will not migrate downward beyond 5.8 m (19 ft) due to the presence of basalt at 5.8 m (19 ft).

**Notes:**

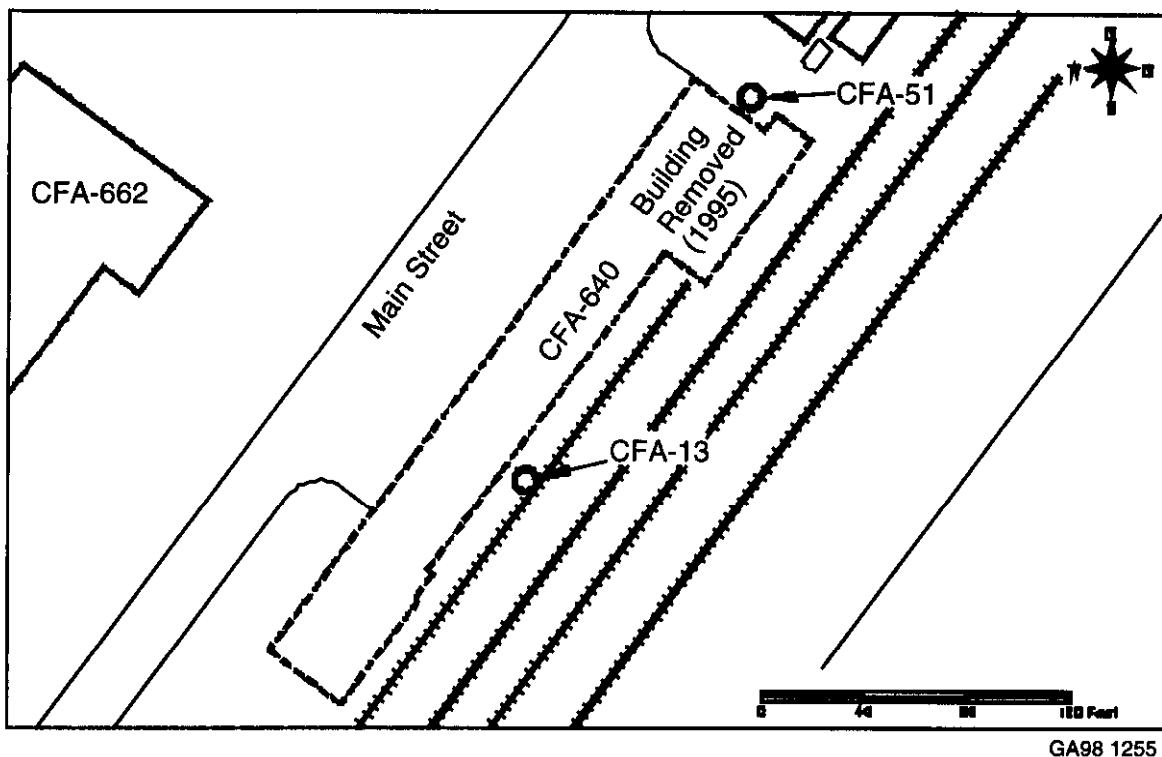
(1) Exposure point concentrations shown for this depth interval represent the 95% lognormal UCL (95 UCL) or maximum detected concentration, whichever is less, for analytical data collected at the site.

(2) Exposure point concentrations (EPC) shown for this depth interval represent volume-weighted concentrations, and are calculated using the following equations:

Depth (ft)	EPC Equation
0-4	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5)]/4$
0-10	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6)]/10$
0-19	$[(C_{0-0.5})(0.5) + (C_{0.5-4})(3.5) + (C_{4-10})(6) + (C_{10-19})]/19$

Where: C = 95 UCL or maximum detected concentration, whichever is less, for the indicated depth interval.

**Figure 4-26. OU 4-11: CFA-05 nature and extent assumptions.**



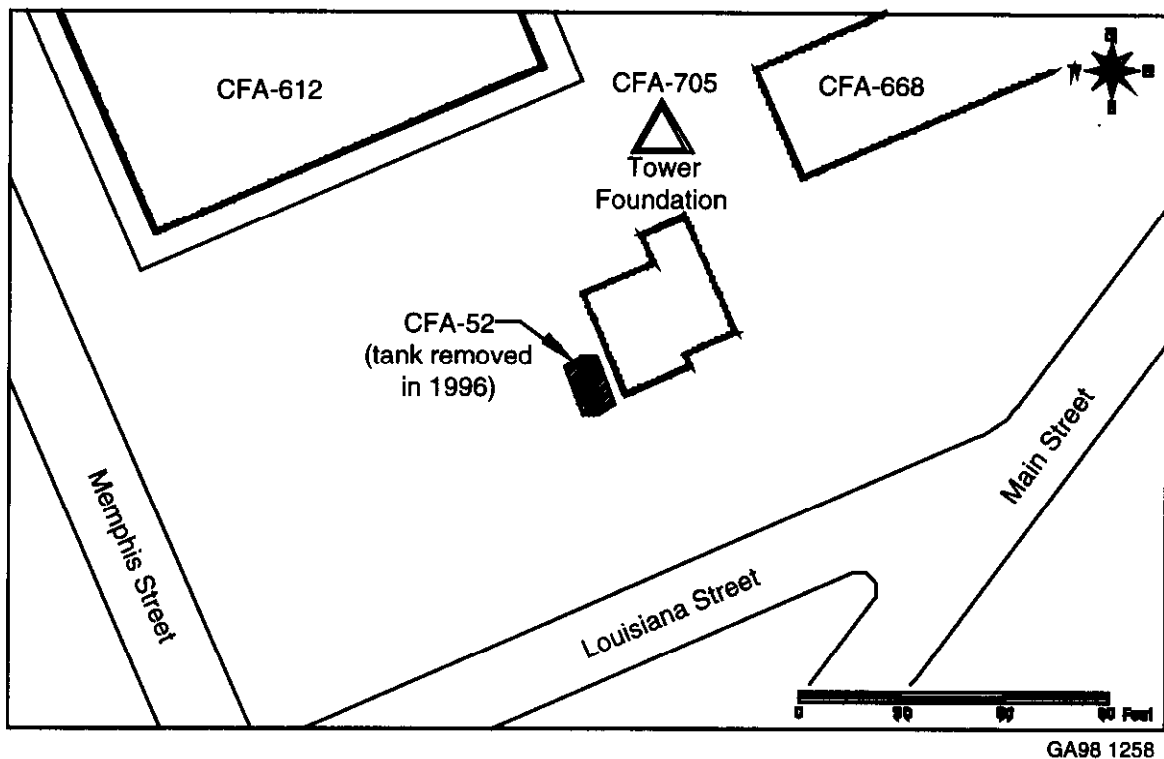
**Figure 4-27.** OU 4-13: CFA-51 Dry Well at North End of CFA-640.

**4.1.16.2 Previous Investigations.** A radiological survey was performed when the dry well was discovered to determine the potential for radiological contamination inside and around the dry well. Alpha radiation was detected on the clay pipe during the survey and was assumed to be a result of thorite, a constituent of the clay pipe. A soil sample was collected from the bottom of the dry well. The sample was analyzed for PCBs, inorganics, and SVOCs. VOC analysis was not performed because process knowledge indicated that contamination would be detected by analysis for SVOCs, which are more persistent in the environment. Summary statistics for CFA-51 are presented in Table C-45. Evaluation of the analytical data in the initial contaminant screen presented in the RI/FS Work Plan identified lead as a COPC. The supplemental contaminant screen presented in Table C-44 and C-45, Appendix C, indicates that lead is below the EPA (1994) 400 mg/kg screening level, and does not require further evaluation.

**4.1.16.3 Nature and Extent of Contamination.** Based on the supplemental contaminant screen, no further evaluation is necessary at the site and CFA-51 is eliminated from further consideration in the BRA.

#### **4.1.17 OU 4-13: CFA-52 Diesel Fuel UST (CFA-730) at Building CFA-613 Bunkhouse**

**4.1.17.1 Site Summary.** The CFA-52 site consists of a 1,893-L (500-gal) UST used to store diesel fuel for heating Building CFA-613 (Figure 4-28). The tank was installed in 1950, abandoned in 1995, and removed in 1996. During tank removal activities, stained soil was observed in the bottom of the excavation, indicating that the tank had leaked. Small holes were also observed in the tank itself. As a result of the release of diesel fuel, the site was added to the FFA/CO.



**Figure 4-28.** OU 4-13: CFA-52 Diesel Fuel UST (CFA-730) at Bldg. CFA-613 bunkhouse.

**4.1.17.2 Previous Investigations.** The tank was removed in April 1996 along with soil contaminated with TPH at concentrations greater than 1,000 mg/kg. Approximately 22.9 m<sup>3</sup> (30 yd<sup>3</sup>) of soil was removed to a depth of approximately 4.9 m (16 ft) when bedrock was encountered. Soil samples were collected from the bottom of the excavation and analyzed for TPH and VOCs. Three contaminants, 1,1,1-trichloroethane, TPH, and tetrachloroethene, were detected. Maximum detected concentrations of these chemicals (0.008 mg/kg, 578 mg/kg, and 0.026 mg/kg, respectively) were below respective residential soil risk-based screening concentrations of 24,300 mg/kg, 1,000 mg/kg, and 12.3 mg/kg. As a result, these contaminants were screened from further evaluation in the Work Plan.

**4.1.17.3 Nature and Extent of Contamination.** All contaminants at CFA-52 were eliminated in the contaminant screening presented in the Work Plan. As a result, supplemental screening was not performed. The potential exists for contaminant migration to groundwater; therefore, CFA-52 is included in Section 6 to assess cumulative risk to groundwater.

## 4.2 CFA Facilities Analysis

### 4.2.1 Introduction

This section presents the results of the WAG 4 facilities analysis. A facility is defined as any building or structure. Many of the facilities at CFA are located near WAG 4 release sites identified in the FFA/CO. This analysis includes a review of all operational, abandoned, and demolished facilities with respect to their potential impact on the cumulative risk posed by WAG 4.

The original facilities at CFA were built in the 1940s and 1950s to house the Naval Gunnery Range and associated personnel. The Fire Station #2 Training Facility was built in 1952. Most of these buildings were demolished by the D&D program. The gun range facility is also included in this evaluation. Facilities at CFA have been modified over the years to fit the changing needs of the INEEL and now provide four major types of functional space; craft, office, service, and laboratory. The primary structures and buildings at CFA are grouped into these general categories. A list of all CFA facilities and associated uses is provided in Appendix E.

**Craft Shops.** The Multi-craft Shops (CFA-621, -622, -623, and -624) house shops for machining, carpentry, electrical repair, mechanical maintenance, sheet metal fabrication, painting, locksmithing, janitorial, signs, offices, and power line services. The crafts housed at this complex support operations at other INEEL facilities.

**Offices.** Buildings at CFA that are primarily used for offices are CFA-614, -615, -627 through -631, -689, and -1610. Office space is also provided in portions of other buildings.

**Services.** Medical services are provided at building CFA-1612 constructed and occupied in 1996. The facility provides space for industrial medical programs, treatment of illnesses and injuries, health education, and emergency medical response. The facility is equipped with a treatment and decontamination facility for management of radioactively-contaminated patients. The original medical facility was housed in building CFA-603 built in 1950, and remodeled in 1981. This facility is now inactive.

Food services are provided in the cafeteria, building CFA-662. The building was built in 1963 and is still in use.

Vehicle maintenance and transportation services are provided by several facilities at CFA. The Bus Depot (CFA-685), built in 1952, is the primary stopping point for INEEL buses traveling to and from surrounding communities. The depot also houses the dispatch office for INEEL taxi and shuttle bus services, as well as the mail service. The transportation Facility (CFA-696) houses bus and equipment maintenance operations. This facility was constructed in 1995 and replaces building CFA-665, the Equipment Repair Shop. CFA-665, built in 1951 was demolished in 1997.

The Helicopter Security and Maintenance Facility (CFA-608), built in 1984, housed INEEL security personnel, helicopters, and equipment until 1996. The building is currently used for excess computers and equipment.

Fire Station No. 1 (CFA-1611) houses the INEEL Fire Department Headquarters, fire fighting equipment, personnel, training areas, and offices. The building was constructed and occupied in 1996. The former fire station was located in building CFA-666.

Warehouses located in buildings CFA-601, -614, and -674 are used for storage of stock inventory and records, receipt/distribution operations, excess property disposal, and offices.

**Laboratories.** The Radiological and Environmental Sciences Laboratory (RESL) (CFA-690), built in 1963, houses laboratories for dosimetry monitoring. Radiological reference standards are also stored at the facility for INEEL and off-site use. The laboratory conducts ecological monitoring, such as sampling and analysis of soil, water, plants, and animals. The U.S. Geological Survey offices are also housed in CFA-690.

The Laboratory Complex (CFA-625), built in 1989, provides analytical laboratory space for analysis and research. The majority of the work conducted in the laboratories involves non-radiological materials; however, some of the laboratory space is equipped to handle materials that contain radioisotopes.

The Standards and Calibration Laboratory (CFA-698), houses a laboratory where calibrations are performed.

The Office Building and Environmental Laboratory (CFA-612), built in 1983, provides offices, classrooms, and laboratories for the analysis of drinking water and air samples collected at the INEEL.

The Health Physics Instrumentation Laboratory (CFA-633), built in 1950 and remodeled in 1981, provides support for the calibration and use of radiological instrumentation at other INEEL facilities. Radiological materials associated with monitoring equipment may be handled in this facility.

#### **4.2.2 Screening of WAG 4 Facilities**

The screening process for CFA facilities included all operational buildings and structures, those no longer being utilized for their original mission, and those that have been abandoned or demolished. Past and current uses of these facilities were investigated to determine whether or not contamination has occurred resulting in a site that was not identified in the FFA/CO, and if there is a potential unacceptable risk associated with the facility. A facility, for purpose of this analysis, is any building or structure. All CFA facilities were eliminated from further consideration, as a result of the screening process, and require no further evaluation or remedial action. The results of the facilities screening is presented in Appendix E.

The screening criteria are discussed below. A facility was eliminated from further consideration if:

1. It is a site assigned to an existing OU in WAG 4 under the FFA/CO
2. It may have processed, stored, or utilized hazardous materials, but has no historical evidence based on process knowledge or specific sample data that a release to the environment has occurred or releases to the environment have been remediated.
3. It would not have processed, stored, or utilized hazardous materials/waste. These facilities would typically include: personnel offices, nonhazardous material storage areas, training/security buildings, personnel support buildings, nonhazardous liquid storage, water facilities, and electrically driven pumping facilities. Materials used in these facilities typically include the use of products that are distributed to the general public.
4. Discharges from the facility to the environment are permitted through other programs and/or are operated with appropriate management controls.
5. Data indicate that releases from tanks are less than the risk-based soil concentrations for BTEX and/or TPH.

#### **4.2.3 CFA Management Controls**

An integral part of the analysis was the review of management control procedures (MCPs) utilized to mitigate potential releases to the environment at CFA. The documents and procedures utilized to

mitigate potential releases to the environment at CFA include: Safety Analysis Reports (SARs) for the nuclear facilities, RCRA Contingency Plans, Spill Avoidance and Response Plans, Emergency Plans Implementing Procedures, and Nuclear Materials Inspection and Storage Procedures. These procedures are designed to specifically address potential releases to the environment at CFA and the appropriate reporting and mitigation measures to be implemented in the case of such an event. In support of these MCPs are standard operating procedures that cover operational aspects of activities at CFA. These procedures are designed to eliminate or minimize the risk of off-normal events. In addition to CFA-specific MCPs, the site contractor has INEEL program requirements. These program requirements include physical hazards, asbestos control, and toxic substance control. The documents described above are discussed in the following sections.

**4.2.3.1 Safety Analysis Reports for Nuclear Facilities.** Department of Energy Order 5480.23, "Nuclear Safety Analysis Reports," requires a safety analysis to be performed for each DOE nuclear facility. The term nuclear facility is defined in this order to include nuclear reactor and nonreactor nuclear facilities, the latter to include "activities or operations that:

1. Produce, process, or store radioactive liquid or solid waste, fissionable materials or tritium.
2. Conduct separation operations.
3. Conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations.
4. Conduct fuel enrichment operations.
5. Perform environmental remediation or waste management activities involving radioactive materials."

The order requires that, contractors perform a hazard analysis of their nuclear activities and classify their processes, operations, or activities in accordance with the following requirements:

- **Classification Categories**—The consequences of unmitigated releases of radioactive and/or hazardous materials shall be evaluated and classified by the following hazard categories:
  - Category 1 Hazard. The hazard analysis shows the potential for significant offsite consequences.
  - Category 2 Hazard. The hazard analysis show the potential for significant onsite consequences.
  - Category 3 Hazard. The hazard analysis shows the potential for only significant localized consequences.
- **Inventory of Hazardous Materials**—The hazard analysis shall be based on an inventory enveloping all radioactive and nonradioactive hazardous materials that are stored, utilized, or may be formed within the nuclear facility.
- **Evaluation of Potential Releases**—The hazard analysis shall identify energy sources or processes that might contribute to the generation or uncontrolled release of hazardous materials. The hazard analysis shall estimate the consequences of accidents in which the

facility of process and/or materials in the inventory are assumed to interact, react, or be released in a manner to produce a threat or challenge to the health and safety of individuals onsite and offsite."

Safety analyses performed in compliance with these requirements contain inventories of potentially releasable hazardous materials. Also, such safety analyses include a listing of barriers to release, which are both physical and administrative, and a discussion of the accident types that might breach the barriers. Guidance is given in DOE standard DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports," on radioactive material inventory levels that would constitute the threshold of each Hazard Category. Although category thresholds are not defined for nonradioactive hazardous materials, the concepts of "localized," "onsite," and "offsite" consequences of a release are applied to those materials as well.

Nonnuclear facilities (those having no radioactive inventories or inventories below the category 3 threshold of DOE-STD-1027-92), DOE limited standard DOE-EM-STD-5502-94, "Hazard Baseline Documentation," gives documentation for various levels of hazardous materials inventories.

Most facilities and operations at the INEEL have a hazard analysis performed that identifies the hazards of the operation and helps initially categorize the facility or operation for further analysis according to the level of hazard established. Activities not included in this would be those whose hazards are obviously of a nature that is routinely accepted by the public (i.e., office work, warehouse, carpentry, welding, etc.). These activities comply with the requirement to maintain Materials Safety Data Sheets.

**4.2.3.2 CFA Emergency Plan/RCRA Contingency Plan.** The INEEL Emergency Plan/RCRA Contingency Plan contains the process for response to and mitigation of any consequences resulting from emergencies that may occur at the INEEL. This plan includes all federal, state, and local emergency plan requirements. It implements appropriate portions of 29 CFR and 40 CFR 264 and 265. This plan will be implemented in the event of fires, explosions, or any unplanned release of hazardous materials to the air, soil, surface and/or groundwater and is designed to minimize any consequences to human health and the environment from these events.

The CFA Spill Avoidance and Response Plan establishes general policy and responsibilities for spill avoidance and response requirements for operations at CFA. It is prepared in accordance with the INEL Environmental Compliance Planning Manual, Section 3.9.2 "Spill Avoidance and Response Plans," DOE Order 5400.1 (General Environmental Protection Program), DOE Order 5500 series (Emergency Preparedness), and 40 CFR 122.26 (National Pollutant Discharge Elimination System Storm Water Permit Regulations).

Facility operations at CFA that have the potential to release hazardous substances (listed in CFR Parts 116, 302, 355, and 372) or petroleum products to the environment, are required to implement the Spill Avoidance and Response Plan unless; (1) they are covered by a RCRA contingency plan, or (2) they store these substances in the same form and concentration as a product packaged for distribution and use by the general public.

**4.2.3.3 Asbestos Control Program.** An asbestos control program at the INEEL establishes mandatory standardized requirements for any asbestos-related work. This program is regulated by the Lockheed Martin Idaho Technologies Company (LMITCO) Program Requirements Document (PRD)-73, entitled Asbestos Control Program. This program lists the requirements of administrative responsibilities, surveillance, exposure and assessment, compliance methodology, and all other aspects of regulating asbestos at the INEEL. Currently, a database software program called HAZ CAD is being implemented at the INEEL to track asbestos-containing material per Federal Regulations.



**4.2.3.4 Toxic Substances Control Act.** The requirements for the use and disposal of PCBs at the INEEL are contained in the Environmental Manual, Number EM-A10 entitled Toxic Substances Control Act. Records of equipment containing PCBs, manifests of all PCB shipments to non-INEEL treatment, storage, and/or disposal facilities, and certificates of disposal are maintained at the INEEL. Records are updated annually in the "Annual Records and Document Log," which is submitted to DOE-ID by July 1 of each year. This is a LMITCO administrative requirement, as well as a 40 CFR 761.180(a) requirement.

As of October 1, 1985 the use of transformers containing PCBs was banned by Federal law if they posed an exposure risk to food and feed, otherwise they can remain in use until replacement is necessary. A transformer in use under these conditions must be registered with the building owners and fire departments. Transformers at the INEEL that contained concentrations of PCBs greater than 50 parts per million (ppm) were replaced as of mid-1990. Materials containing PCBs (including those that are under 50 ppm and above 25 ppm) are disposed at EPA-approved sites.

**4.2.3.5 Management of Storage Tanks.** Management of INEEL storage tanks is performed in accordance with LMITCO MCP-456. This procedure applies to installation, management, operation, record-keeping, and closure of storage tanks. A storage tank is defined as, "a stationary device designed to contain an accumulation of a regulated substance and constructed of non-earthen materials (such as concrete, steel, or plastic that provide structural support, including all ancillary piping."

This procedure does not apply to

- Septic tanks
- Storm-water or waste water collection systems
- Flow-through process tanks
- Any tank system with a capacity of 110 gallons or less
- Any tank system that contains a de minimus concentration of regulated substances
- Any emergency spill or overfill containment system that is expeditiously emptied after use
- Any tank containing a regulated substance that is not in a liquid state at standard pressure and temperature
- Any tank holding hazardous waste listed or identified under Subtitle C of the Solid Waste Disposal Act, or a mixture of such hazardous waste and other regulated substances
- Any wastewater treatment tank system that is part of a waste water treatment facility regulated under Section 402 or 307(b) of the Clean Water Act
- Equipment or machinery that contains regulated substances for operational purposes such as hydraulic lift tanks and electrical equipment tanks
- Surface impoundments, pits, ponds, and lagoons.

## 4.3 Nature and Extent of Contamination in Groundwater At WAG 4

The purpose of this section is to evaluate groundwater data collected from wells in the vicinity of CFA and, if possible determine the source(s) of groundwater contaminants at CFA. The contaminants which are analyzed are those COPCs identified in the "Work Plan (McCormick, et al., 1997). These COPCs were identified using aquifer and perched water sample data, and maximum potential risk posed by sufficiently mobile soil contaminants. The COPCs include 15 nonradionuclides and 11 radionuclides (Table 4-1).

### 4.3.1 Aquifer Monitoring Wells

Most of the SRPA wells in the vicinity of the CFA were installed and are sampled annually. Several additional groundwater wells, predominately at the INEEL landfills, were installed and are sampled quarterly as part of the Post-ROD monitoring for the OU 4-12 landfills. Figure 4-29 illustrates the location of 41 groundwater wells from which monitoring data was obtained.

**4.3.1.1 Aquifer Water Levels.** The potentiometric surface of the Snake River Plain aquifer in the vicinity of the INEEL is depicted in Figure 4-30. This figure is illustrated using 5 ft contour intervals and water levels collected during October 1996. These water levels were collected from 38 monitoring wells located in the central and southern portion of the INEEL. The regional flow or gradient of the aquifer is perpendicular to the equipotential lines. The regional flow is to the south-southwest, although, locally, the direction of groundwater flow is affected by recharge from rivers and inhomogeneities in the aquifer. Across the INEEL, the average gradient of the water table is approximately 4–5 ft/mile.

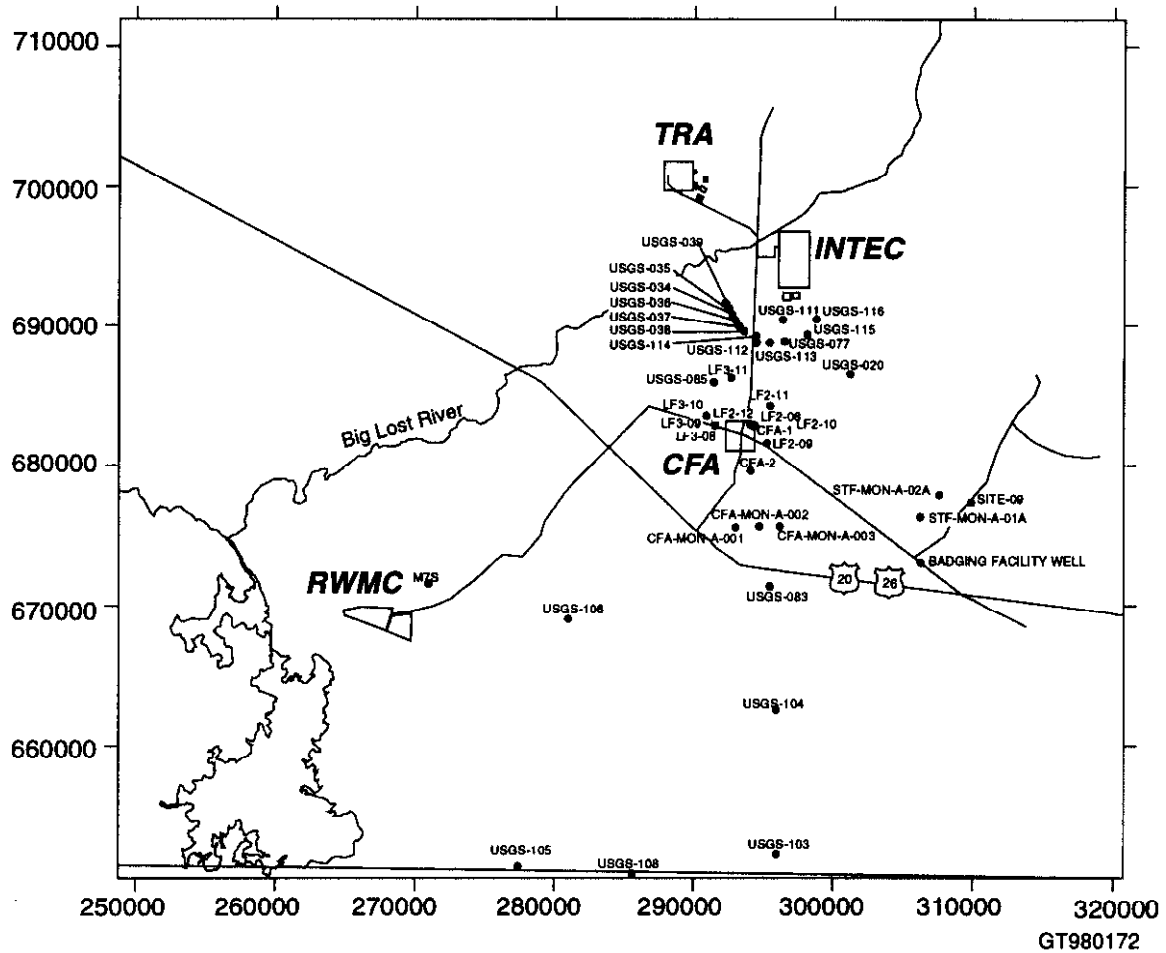
The direction of groundwater movement in the vicinity of CFA is illustrated in Figure 4-31. This figure was constructed using the same data as Figure 4-30, however, 1 ft contour intervals are used to aid in depicting local flow directions. It is apparent from the groundwater elevation contour map (Figure 4-31) that at a smaller contour interval appears to illustrate the complexity of the water table surface of the Snake River Plain aquifer. This complexity noted at the smaller scale, is due to the variety and degree of interconnection of the water bearing zones that affect the water table at a smaller scale but tend to average out on a larger scale. However, it is apparent from these figures (4-30 and 4-31) and contaminant concentration diagrams that groundwater at/near the INTEC area flows in the south south-westerly direction toward CFA and RWMC. Therefore, contaminants injected or leached into the groundwater at/near INTEC potentially influence the concentration of contaminants detected in the groundwater at CFA.

**4.3.1.2 Groundwater Data.** A search was conducted of the USGS and the Environmental Restoration Information Services (ERIS) databases for the analytical data related to the COPCs. The search revealed that wells within the vicinity of CFA are analyzed for 21 of the 26 COPCs. Data for many of these COPCs were collected in the past, are not presently being monitored. This information is presented in Table 4-2, which lists the COPCs that are/were monitored and the number of wells that are/were sampled for each constituent.

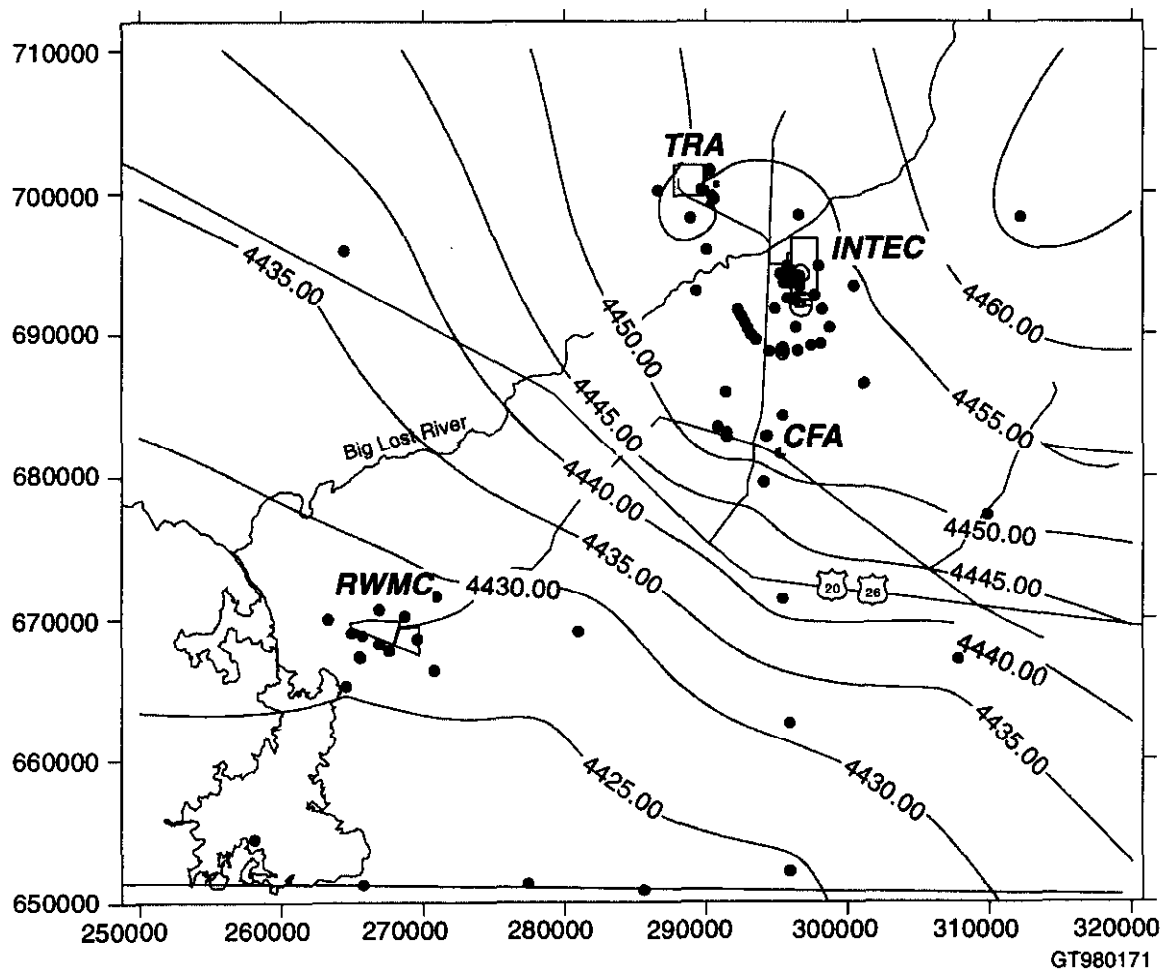
The data from the 21 COPCs were tabulated to illustrate the number of positive detections and concentrations, number of nondetects, and overall sampling period for each well. These data are presented in Appendix G, Tables G-1 through G-22.

**Table 4-1. COPCs identified at CFA groundwater wells.**

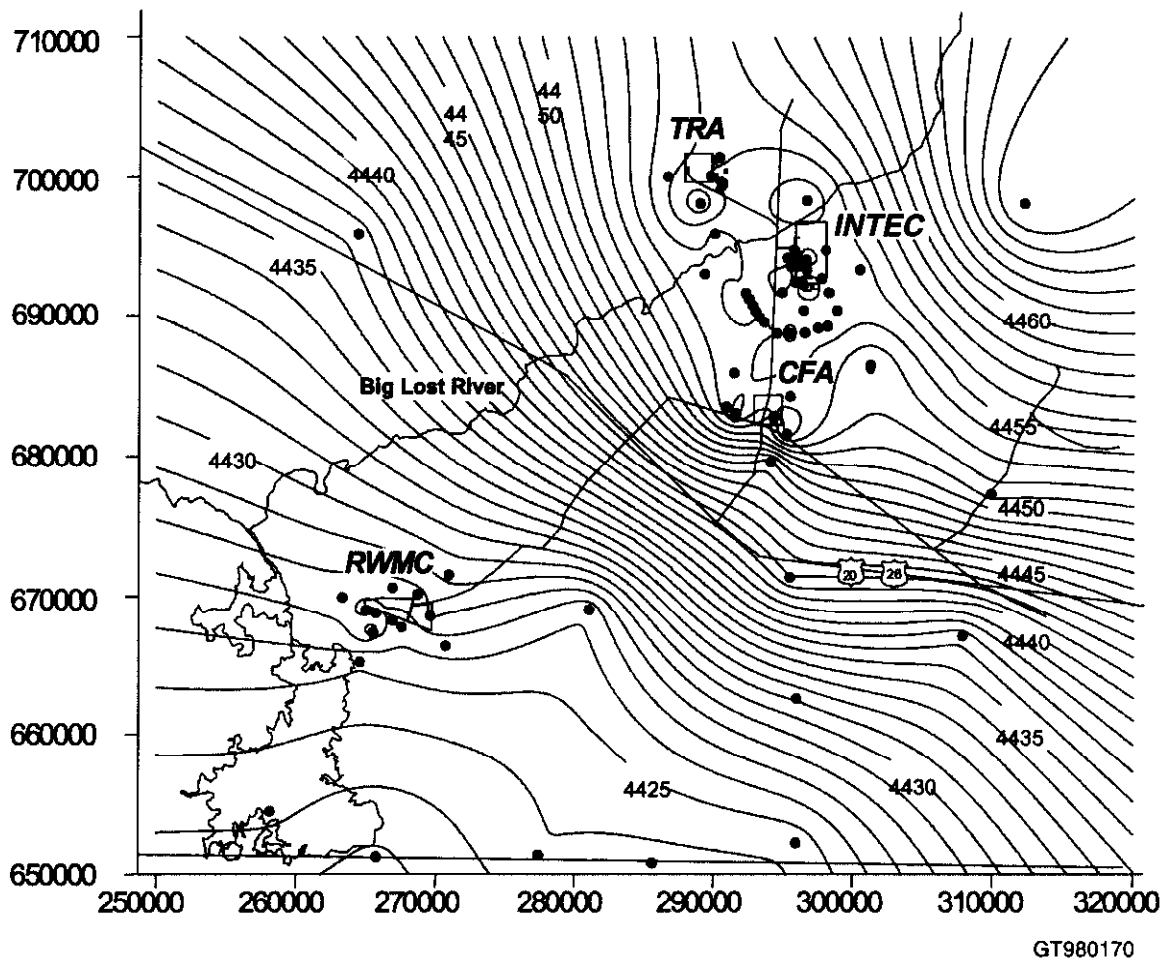
Wells/Hydraulic Location	Screened Interval	Pump Depth	COPC
CFA-1/upgradient	444-639	NA	1,2-Dichloroethane
CFA-2/downgradient	521-651	NA	Aroclor-1254
LF2-08/downgradient	485-495	NA	Aroclor-1260
LF2-09/downgradient	469-497	NA	Arsenic
LF2-10/downgradient	725-765	NA	Benzaldehyde
LF2-11/upgradient	466-499	NA	Beryllium
LF2-12/downgradient	470-492	481	Cadmium
LF3-08/downgradient	500-510	NA	Chloromethane
LF3-09/downgradient	480-500	493	Chromium
LF3-10/downgradient	481-501	494	Mercury
LF3-11/upgradient	472-492	485	Phenol
CFA-MON-A-001/ downgradient	488-518	512	TPH-gasoline
CFA-MON-A-002/ downgradient	488-518	512	TPH-diesel
CRA-MON-A-003/ downgradient	491-511	494	Trichloroethen
USGS 85/upgradient	522-614	522	Zinc
USGS 104/downgradient	550-700	598	Am-241
USGS 103/downgradient	575-760	615	Cs-137
USGS 106/downgradient	400-760	585	H-3
USGS 108/downgradient	400-760	637	I-129
USGS 105/downgradient	400-800	700	Pu-238
M7S/downgradient	598-628	621	Pu-239
USGS 34/upgradient	500-578	522	Pu-240
USGS 39/upgradient	NA	490	Sr-90
USGS 3/upgradient	689-740	NA	U-234
USGS 36/upgradient	430-567	523	U-235
USGS 37/upgradient	507-571	509	U-238
USGS 38/upgradient	678-729	523	
USGS 111/upgradient	442-600	509	
USGS 112/upgradient	430-563	509	
USGS 113/upgradient	443-561	509	
USGS 077/upgradient	470-586	503	
USGS 114/upgradient	440-560	509	
USGS 115/upgradient	437-580	509	
USGS 116/upgradient	401-572	509	
USGS 020/upgradient	515-552	523	
SPERT-DISP-3/cross gradient	100-225	NA	
STF-MON-A02A/cross gradient	510-530	523	
STF-PIE-A02A/cross gradient	NA	NA	
SITE-09/cross gradient	1000-1140	523	
ORME/cross gradient	NA	NA	
STF-MON-A01A/cross gradient	NA	NA	
Badging Facility Well/cross gradient	NA	NA	
EOCR Production Well/cross gradient	1052-1237	NA	
EOCR Injection Well/cross gradient	NA	NA	



**Figure 4-29.** Location of groundwater monitoring wells in the vicinity of CFA.



**Figure 4-30.** October 1996 potentiometric surface of the Snake River plain aquifer near CFA, using 5 ft contour intervals..



**Figure 4-31.** October 1996 potentiometric surface of the Snake River plain aquifer near CFA, using 1 ft contour intervals.

**Table 4-2. Monitoring of CFA groundwater wells.**

Contaminant of Potential Concern	Number of Wells Monitored (a maximum of 41)
Radionuclide Contaminants	
Am-241	16
Cs-137	31
H-3	41
I-129	27
Pu-238	16
Pu-239	1
Pu-240	16
Sr-90	35
U-234	5
U-235	6
U-238	5
Nonradiological Contaminants	
1,2-Dichloroethane	39
Aroclor-1254	0
Aroclor-1260	0
Arsenic	41
Benzaldehyde	0
Beryllium	40
Cadmium	39
Chloromethane	40
Chromium	40
Mercury	39
Phenol	7
TPH-gasoline	0
TPH-diesel	0
Trichloroethene	40
Zinc	31

COPC concentrations were tabulated along with established background groundwater concentrations, maximum contaminant levels (MCLs), and risk-based concentrations in Tables G-22 through G-24, respectively. Risk based concentrations were obtained from the WAG 4 OU 4-13 RI/FS Work Plan (McCormick, et al, 1997). These tables were constructed based on the following assumptions: (1) if duplicate samples were taken, the highest concentration is tabulated; (2) if one of the samples indicated the presence of a constituent and the duplicate sample did not, the positive sample was plotted and the nondetect was disregarded; (3) a positive detection for a radionuclide is a concentration that equaled or exceeded 2 sigma (95% confidence limit based on the uncertainty); (4) if no background groundwater concentration had been established for a specified constituent, zero was used as the background value and any positive detection was classified as a concentration above background levels and; (5) all data with "u" data flags were considered zero and all data with "r" data flags were considered unusable. Radionuclides with sample concentrations that were less than 2 sigma were considered to be non-detected. Radionuclide concentrations that are less than 2 sigma are considered statistically "non-positive."

Trend analyses and concentration contour diagrams for the COPCs for which sufficient data are available are illustrated in Burgess (1998). The concentrations used for contouring were predominately from 1995 to 1997. The data used to construct the concentration diagrams is also provided in Burgess (1998). The concentration contour diagrams include the regional area (maximum of 41 wells) around the RWMC and a separate set that consists of concentrations obtained from wells at CFA.

**4.3.1.2.1 1,2-Dichloroethane**—1,2-Dichloroethane is widely distributed in the environment at trace concentrations because it is used predominately as a solvent in industrial, agricultural, and household products. The MCL for 1,2-Dichloroethane is 5 ug/L. 1,2-Dichloroethane is not naturally occurring and true background concentrations should be zero. Knobel, et al. (1992) suggest that background concentrations of 1,2-dichloroethane in water from the Snake River Plain aquifer is less than 0.2 ug/L. A total of 39 wells in the regional area near CFA were monitored for 1,2-dichloroethane. Only 2 wells indicated a positive detection. The only well at CFA which reported a positive detection was well CFA-1 (0.6 ug/L). The other positive detection was from well M7S (0.8 ug/L), located down the hydraulic gradient near RWMC. See Table G-1 for a summary of all collected 1,2-dichloroethane data from the 41 wells. Both of these wells have had additional sampling since the 1993 positive detection in which concentrations were below the detection level. Both of these positive samples were above the background and risk-based concentrations (0.3 ug/L, risk= $10^{-6}$ ). However, neither of these concentrations were above the MCL of 5 ug/L.

**4.3.1.2.2 Americium-241**—The risk-based concentration for Am-241 is 0.145 pCi/L ( $10^{-6}$  risk). The MCL for Am-241 is 6.34 pCi/L. Am-241 is anthropogenically present in groundwater as a fission product of nuclear weapons tests and as a result of disposal practices in the nuclear industry. Therefore, the true background is not zero, however, Knobel et al., (June 1992) states that the background concentration in the SRPA is essentially zero. The only possible site at CFA from which Am-241 was released is the STP drainfield. Am-241 was generated at two CFA facilities that laundered radioactively contaminated protective clothing. The effluent from these facilities was discharged to the drainfield. The total activity of Am-241 discharged to the drainfield is estimated at 9.3 E-03 Ci (McCormick 1997).

Sixteen of the 41 monitor wells in the regional vicinity of CFA have been measured for Am-241. In general, only the USGS wells are measured for this contaminant. All of the monitored wells are located upgradient of CFA, except for well M7S which is located near RWMC. However, only 11 of these 16 wells have been monitored for Am-241 since 1994. Four of the 16 wells tested for Am-241 have had a single positive detection each. These samples were collected in 1994–1995. The maximum concentration is from well USGS 112, located near INTEC, contained 0.21 pCi/L. All 4 of these wells are located upgradient of CFA. Several wells at ARA and PBF have positive detections from gross alpha



samples in both soil and groundwater, indicating the possible presence of Am-241. However, no wells at CFA have been monitored for Am-241, therefore, the extent of contamination is not known.

Samples from these 41 wells have not exceeded the MCL for AM-241. Only the single sample from USGS 112 exceeded the risk based concentration. All 4 samples collected from USGS 34, 36, 39, and 120 exceeded the background concentration for Am-241.

Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that the maximum aquifer Am-241 concentration at INTEC was 0.91 pCi/L in 1986. However, because of the slow decay rate and high Kd value, the concentrations in the aquifer are expected to decline slowly. In the year 2095, the predicted maximum Am-241 aquifer concentration is 0.63 pCi/L which is still higher than the  $10^{-6}$  risk concentration and less than the MCL. After 2095, the concentrations continue to decline and are predicted to fall below the  $10^{-6}$  risk level after the year 2500. During that time period, the aquifer area above the  $10^{-6}$  risk concentration is limited to the areas in the vicinity of INTEC. Based on the model results (Schafer et al., 1996), the concentration contours which exceed the MCL and risk based concentration near INTEC do not affect the area near CFA. However, no wells in the area near CFA have ever been monitored for Am-241.

The only possible site at CFA from which Am-241 was released is the STP drainfield. Am-241 was generated at two CFA facilities that laundered radioactively contaminated protective clothing. The effluent from these facilities was discharged to the drainfield. The total activity of Am-241 discharged to the drainfield is estimated at  $9.3 \text{ E-}03 \text{ Ci}$  (McCormick 1997).

**4.3.1.2.3 Arsenic**—The MCL for arsenic is 50 ug/L. The background concentration for arsenic is 2 to 3 ug/L (Orr et al., 1991). The risk based concentration for arsenic is 0.05 ug/L (risk =  $10^{-6}$ ).

Arsenic is regularly monitored in wells near CFA and several USGS wells between INTEC and CFA. Arsenic has been analyzed in all of the 41 wells in the vicinity of CFA. Most of these samples have been collected since 1986. All of these wells have detected arsenic in at least one sample, indicating that arsenic is a widespread contaminant in the SRPA in the vicinity of CFA.

Trend analysis indicates that wells LF3-08, LF3-09, LF3-10, CFA-1, CFA-MON-A-001, CFA-MON-A-002, LF2-08, LF2-10, LF2-11 and USGS 85 reflect increasing concentrations since 1995-96 (Burgess 1998). However, the trend for most of these wells consists of only 3–5 samples collected in this time period.

None of the 41 wells contained concentrations of arsenic above the MCL. However, 25 wells had at least one sample with a concentration above background. All of the 41 wells contained at least one sample with a concentration above the risk based concentration. The highest concentrations from these wells were detected in well M7S (4.8 ug/L), located near RWMC, STF-MON-A-01A (3.4 ug/L) and -02A (3.8 ug/L), located near ARA, and USGS 112 (3.3 ug/L), located immediately south of INTEC. These findings suggest that arsenic is widely distributed in the aquifer near CFA and that there are source(s) contributing to the groundwater upgradient of CFA. However, the source(s) of this contaminant which affects concentrations at CFA is not distinguishable using present data.

Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that arsenic concentrations in the aquifer never exceed the MCL. Model predictions simulated contaminant transport from the present time through the year 2995. Arsenic peak risk concentrations ( $10^{-6}$ ), originating from INTEC, affect the CFA in the year 2095 through 2955. The  $10^{-6}$  risk based concentration is exceeded throughout this time period in the CFA area. Examination of the vadose zone peak concentration and

mass flux to the aquifer suggests that the concentration of arsenic in the aquifer will decrease very slowly, and that it will remain above the risk based concentration for at least through the year 3095 near INTEC.

**4.3.1.2.4 Beryllium**—The MCL and risk based concentration for beryllium is 4 ug/L and 0.2 ug/L, respectively. No background concentration for beryllium has been established for the SRPA. Forty of the 41 wells in the vicinity of CFA have been sampled at least once for beryllium. Most of the wells at CFA are regularly monitored for beryllium while the other wells away from the facility are not.

Of the 40 wells sampled for beryllium, only 4 wells have detected this constituent. These wells include M7S, located near the RWMC, wells CFA-1, LF2-08, and LF2-09, which are all located at CFA. Well M7S is the only well in which beryllium was detected on more than one occasion. This well has had a total of 12 nondetects and 3 detects. All of the positive beryllium detections at the CFA wells were collected during the same sampling event (6/93).

Due to the fact that beryllium is not continuously monitored in most of the wells located outside of CFA inconsistent positive detections, and positive detections in both soil and groundwater near ARA and PBF, the location of the source area(s) to the groundwater is not apparent.

**4.3.1.2.5 Cadmium**—The MCL for cadmium is 5 ug/L and the background concentration in the SRPA is <1 ug/L (Orr et al., 1991). The risk-based concentration for cadmium is 20 ug/L (risk HI=1).

Thirty-nine in the vicinity of CFA have been sampled for cadmium at least once. Most of the wells at CFA are regularly (quarterly) monitored for cadmium. Eighteen of these wells have produced at least one sample with concentrations above the MCL. Nineteen wells have had at least one sample with concentrations above the background level. Well LF2-11 (located at CFA) is the only well to have a concentration (120 ug/L) above the risk based concentration. During the collection of this sample from well LF2-11. A duplicate sample from this well contained a concentration of 93 ug/L.

Trend analysis indicate all of the wells in the vicinity of CFA have decreasing cadmium concentrations since 1995 (Burgess, 1998). Most of the wells at CFA were installed and began the long term monitoring programs initiated in 1993.

Many of the wells at CFA have both filtered and unfiltered samples for cadmium. The analytical data from filtered samples collected from these wells are nondetect while the unfiltered samples had positive detections. Also, validation of the data indicated that many of the duplicate analyses were outside of analytical control limits. The inconsistency in the data suggests that the results are possibly false positives or potential anomalies.

Based on the available data, it is apparent that cadmium is wide spread throughout the south-central portion of the INEEL. Data collected during the OU 4-12 Landfills project appear anomalous and samples from wells located outside of CFA are not consistently analyzed for cadmium. Also, cadmium has been detected soil and groundwater above background levels, at INTEC, TRA, (both facilities are located upgradient) and CFA. Cadmium was also detected in soil samples from ARA, located cross-gradient from CFA. Cadmium concentrations above background levels are also present at the RWMC, located down-gradient from CFA. It is unlikely that a source of cadmium exists at CFA due to the wide distribution in the soil and groundwater.

**4.3.1.2.6 Chloromethane**—The MCL for chloromethane has not been established. Chloromethane is not naturally occurring in the environment; therefore, the true background concentration should be zero. The risk based concentration is 6.55 ug/L.

Forty wells in the vicinity of CFA have been sampled at least once for chloromethane. All of the wells at CFA and several wells immediately downgradient of INTEC are regularly analyzed for chloromethane. However, chloromethane has not been detected in these wells. Well M7S is the only well, out of the 40 wells, which has ever had a positive detection. The duplicate sample collected at the time of this detection did not contain a concentration above the detection limit. Well M7S has also had 16 non-detects. Therefore, based on the available data, chloromethane does not appear to be present in the groundwater at CFA, nor within the regional area around CFA.

**4.3.1.2.7 Chromium**—Historically, chromium primarily has been used at the INEEL for cooling tower operations. In 1972, chromium was replaced as a corrosion inhibitor by a polyphosphate. Chromium also is naturally occurring in the SRPA as a component of basaltic magmas. Chromium is found in spinels in the olivine-rich inclusions of basaltic rocks (Deer, Howie, and Zussman, 1967). The background concentrations of chromium in water from the SRPA generally range from about 2 to 3 ug/L (Orr, Cecil, and Knobel, 1991). The MCL for total chromium is 100 ug/L. The risk based concentration is 200 ug/L (risk = HI = 1).

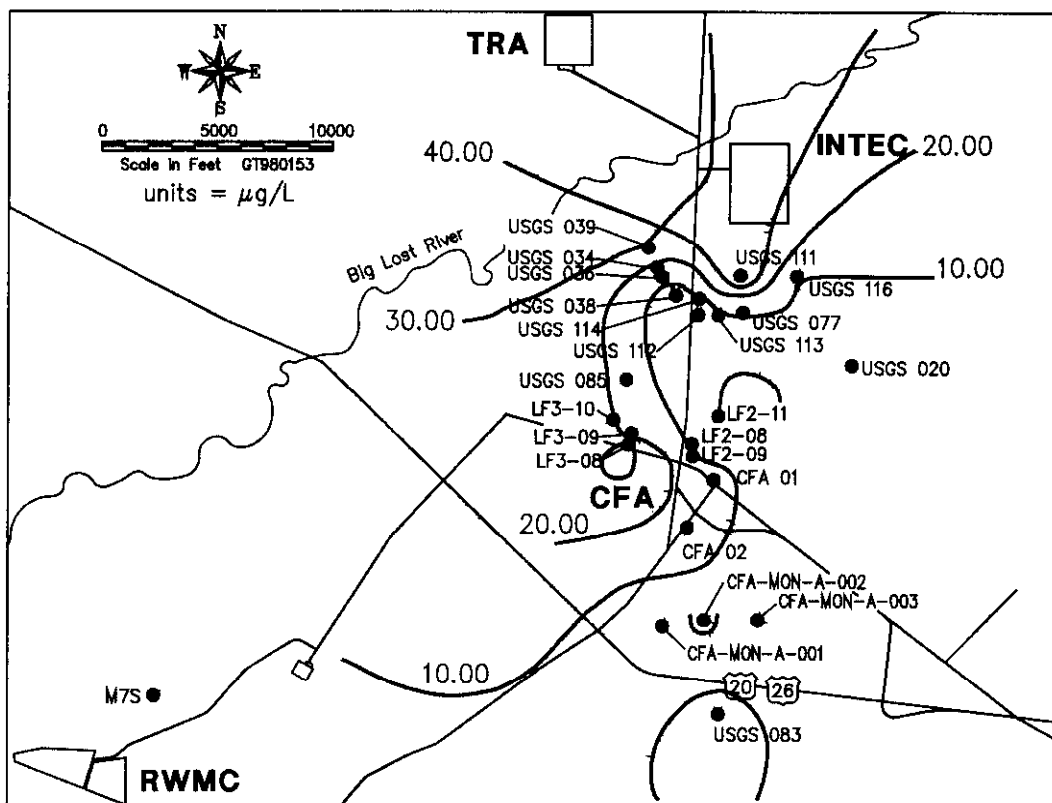
All of the 41 wells in the vicinity of CFA have been sampled for chromium at least once. Most of these wells are monitored regularly for chromium. Well CFA-MON-A-003 is the only well where chromium was not detected above the detection limit. Also, all of these wells have chromium concentrations above background concentrations. However, none of these 41 wells have ever had a concentration above the MCL or risk based concentration.

Trend analysis indicate the following wells have increasing concentrations of chromium since sampling began in 1993; CFA-2, LF 3-09, and LF 3-10, (Burgess, 1998). The following USGS wells have increasing concentrations since 1976; USGS 20, 34, 35, 36, 37, 39, 85, 106, 111, and 116 (Burgess, 1998). These wells are located up and downgradient from CFA, indicating chromium concentrations are increasing throughout the area south of INTEC/TRA.

Groundwater concentration contours indicate chromium concentrations are high near INTEC and decrease downgradient toward CFA and RWMC (Figure 4-32). These data indicate that chromium is directly attributable to past waste disposal practices at INTEC and probably TRA, located upgradient of CFA. Another source of chromium in samples was stainless steel pumps, manufactured in part with high-chromium stainless steel, which contributed to chromium concentrations during 1989–90. These pumps were replaced with other pumps constructed with non high-chromium metals during the OU 4-12 RI/FS and chromium detections dropped accordingly.

The documented disposal of chromium at upgradient facilities TRA and INTEC, and their measurable effect on concentrations of chromium in the aquifer indicate that potential source(s) at CFA are nonexistent or overshadowed by concentrations from these upgradient sources. Also, one explanation for the higher concentrations of chromium in the landfill wells at CFA in 1989 and 1990 are due to type of pumps previously used.

Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that chromium concentrations, originating from TRA and INTEC, do not affect the CFA area above the MCL or risk based concentrations. Their model predictions indicated that most of the chromium reaching the aquifer resulted from past disposal practices at the TRA facilities. The chromium in the INTEC vicinity originates primarily as a result of contaminated soils which should be currently bound in the vadose zone sediments. Schafer et al., (1996) suggests that the INTEC contribution of chromium is predicted to reach the aquifer in levels of 1/100<sup>th</sup> the MCL after year 2020 near INTEC. They also state that the maximum concentration in the aquifer should have occurred during the 1966–1971 time period and that this peak occurs in the TRA area. Chromium concentrations in the aquifer fell below and remains below the HI=1



**Figure 4-32.** 1995–1996 chromium concentrations in the Snake River Plain aquifer near CFA. Concentrations in ug/L.

risk level in 1984, and remains below the MCL by 2003 in the TRA area only. Due to the groundwater flow direction, most of the chromium in the aquifer from TRA remains west of CFA.

**4.3.1.2.8 Cesium-137**—The MCL for cesium-137 is 200 pCi/L. The background concentration in the SRPA has not been established. The risk based concentration is 1.51 ( $10^{-6}$  risk) pCi/L.

Thirty-one of the 41 wells in the vicinity of CFA have been sampled at least once for cesium-137. The only well in which Cs-137 has been detected is CFA-2. This sample was collected October 1987 and had a concentration of 60 pCi/L. The only other sample from this well was collected five years earlier and cesium-137 was not detected. The only well at CFA which is regularly sampled for cesium-137 is LF2-10. This well has been sampled 7 times since November 1994 with no detections of cesium-137. USGS wells, located between INTEC and CFA, are regularly sampled (since 1994) for cesium-137.

Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that cesium-137 concentrations, originating from INTEC, do not affect CFA above the MCL or risk based concentration. These model predictions simulated contaminant transport from 1959 through 2227.

**4.3.1.2.9 Iodine-129**—The MCL for iodine-129 is 1 pCi/L. The background levels in the SRPA are 0.05 pCi/L (Orr et al., 1991). The risk based concentration for iodine-129 is 0.295 pCi/L ( $10^{-6}$  risk).

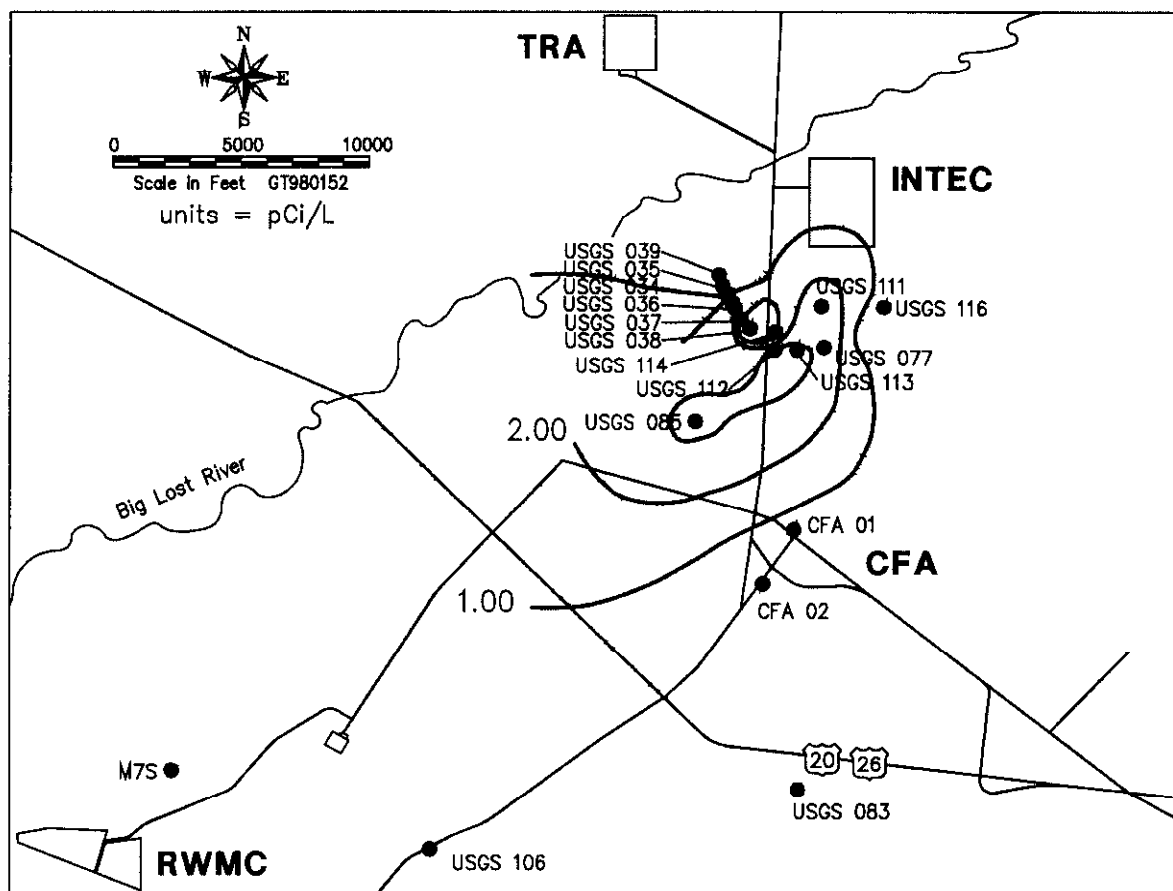
Twenty-seven in the vicinity of CFA have been sampled for iodine-129. Iodine-129 was detected on 17 of the 27 wells at least once during their sampling history. Wells at CFA which iodine-129 was

detected are CFA-1, CFA-2, LF2-12, and LF3-09. The remaining wells with positive detections for iodine-129 are located between INTEC and CFA. Most of these wells have been sampled only 3–5 times over the past 10–15 years, therefore trend analyses are not very meaningful.

The only well at CFA with iodine-129 above the MCL is LF2-12. This well was sampled in June 1995, and is the only sample analyzed for iodine-129 from this well. Well M7S, located near the RWMC, is the only well downgradient from CFA/INTEC where iodine-129 was detected above the MCL. The remaining 9 wells where iodine-129 was detected above the MCL are located between INTEC and CFA.

The concentrations are above background at 16 of the 17 wells where iodine-129 was detected. Four of these 16 wells are located at CFA; CFA-1, CFA-2, LF2-12, and LF3-09. Fourteen of the 17 wells contain concentrations above the risk based concentrations. Three of these wells are located at CFA, CFA-1, LF2-12, and LF3-09.

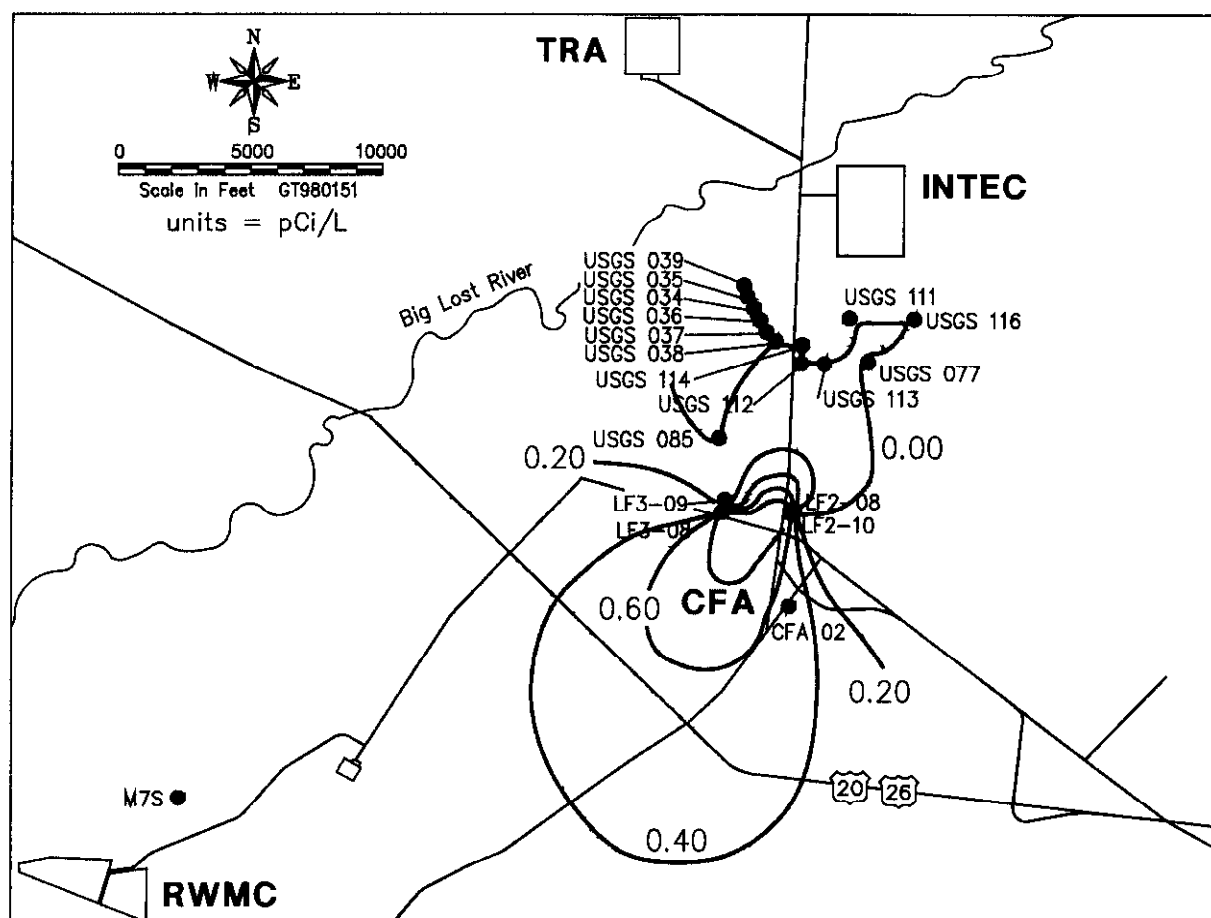
Iodine-129 concentration diagrams from 1986 indicate that the wells between INTEC and CFA contain the higher concentrations (Figure 4-33). However, using 1995 data, most of those same wells between INTEC and CFA indicate no detects or small concentrations of iodine-129 while the wells at



**Figure 4-33.** 1986 iodine-129 concentrations in the Snake River Plain aquifer near CFA.

CFA have the higher concentrations (Figure 4-34). These figures imply that the bulk of the iodine-129 contamination has moved downgradient from the INTEC area. The source of I-129 is believed to be and injection well formerly used at INTEC. However, it is difficult to directly compare these figures because the landfill wells (9 wells total) at CFA were not installed until 1990.

Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that iodine-129 peak concentrations are greater than the MCL and  $10^{-6}$  risk-based concentration. However, the predicted concentrations are greater than measured concentrations. Contour diagrams illustrate that concentrations above the MCL and risk based level will affect the CFA area from 1959 (model prediction began) through 2939 (model prediction ended). However, field measurements on this order have not been recorded. Schafer et al., (1996) suggest the lower recorded concentrations could be indicative of (1) I-129 being absorbed both in the aquifer and vadose zone interbed material or (2) a much larger source term than actually exists at the vadose zone surface. The first possibility would result in (a) transport being much slower than predicted; (b) measured water concentrations being lower than predicted; (c) a strong possibility that field measurements of iodine-129 are recording the mass disposed of into the injection well as opposed to the mass predicted that should arrive from the vadose zone; and (d) iodine-129 being sorbed in the alluvium rather than already having been transported to the top of the



**Figure 4-34.** 1995 iodine-129 concentrations in the Snake River Plain aquifer near CFA. Concentrations in pCi/L.

basalt unit. The second possibility would result in overall lower concentrations arriving from the vadose zone to the aquifer within the time frame predicted by this model parameterization.

Schafer et al., (1996) stated that comparisons of their aquifer model predicted concentrations to field data show that predicted concentrations are above measured values in all cases and appear to predict earlier arrival of iodine-129 in the wells than actually observed.

**4.3.1.2.10 Mercury**—The MCL for mercury is 5 ug/L. Background concentrations in the SRPA are 0.1 ug/L (Orr et al., 1991). The HQ=1 based concentration is 3.65 ug/L.

Mercury was analyzed for at least once in 38 wells in the vicinity of CFA and almost all of these wells are regularly sampled for mercury. Data collected from twelve of the 38 wells indicate detections of mercury in at least one sample. Four of the 12 wells are located at CFA; CFA-1, LF2-08, LF2-12, and LF3-08. However, concentrations in these wells have never exceeded the MCL or risk-based concentration. Six of the 12 wells are located between INTEC and CFA. The “badging facility” well, located southeast of CFA, has detected mercury in one sample collected August 1985. Well M7S, located downgradient near the RWMC, has had mercury detected on two sampling occasions. Nine of the 12 wells have concentrations above background levels. Three of these wells are located at CFA, while the majority are located between INTEC and CFA.

Trend analysis indicate the only well with an increasing mercury concentration through time is LF2-12 (Burgess, 1998). A total of four samples have been analyzed for mercury from this well. In 1993 mercury was not detected in three samples. However, in June 1995 a sample containing 0.44 ug/L was collected from this well. Overall, the other 11 wells in which mercury has been detected in the past indicate concentrations of mercury in the vicinity of CFA are decreasing. During the two sampling periods in 1996 and 1997 the only well in which mercury was LF2-08 (0.1 ug/L). This concentration is at background levels for the SRPA.

Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that mercury concentrations, originating from INTEC, would not affect the CFA area at levels above MCL or risk based concentrations. The model predictions simulate contaminate transport from the year 1959 through 2118. Schafer et al., (1996) also states that because the simulations were terminated before the bulk of the mass had left the vadose zone at INTEC, the concentrations in the aquifer are the result of mercury discharged into the injection well and from dispersion downward from the soil sources. The overall maximum mercury concentration in the aquifer is  $7.42 \times 10^{-3}$  mg/L with the peak concentration in 2095 equal to  $4.17 \times 10^{-3}$  mg/L at INTEC. If the vadose zone simulations had been run out another several thousand years, the mercury in the vadose zone at INTEC would eventually reach the aquifer. However, the simulation was stopped before the concentrations dropped below the MCL and HQ=1 based concentration. Schafer et al., (1996) indicates this was justified because the aquifer contour plots illustrate that the mercury source will remain beneath INTEC and slowly decrease in concentration primarily as a result of dispersion. The most likely source of mercury as a result of injection at INEEL. The only possible source of mercury at CFA would be landfill 2. However, disposal records indicate only 2 kg of mercury was disposed to the landfill.

**4.3.1.2.11 Phenol**—The MCL for phenol has not been established. Phenol does not naturally occur in the SRPA, therefore the true background should be zero. The HQ=1 based concentration is 0.003 ug/L.

Seven wells in the vicinity of CFA have been sampled for phenol. Six of the wells are located between INTEC and CFA. These six wells are USGS wells and have been sampled once for phenol in

1995. Phenol was not detected in the wells. None of these wells detected phenol above the detection limit. Well M7S is the only other well within the vicinity of CFA which has been sampled for phenol. This well is regularly monitored for phenol and has been sampled a total of 10 times since 1992. Phenol has not been detected in well M7S. No wells at CFA are sampled for phenol, therefore it is difficult to determine if phenol is present in the groundwater at CFA. Also, coupled with the infrequent sampling of wells upgradient of CFA, it is difficult to determine if phenol is present and where these source area(s) are located. However, the limited data suggests that phenol is probably not widespread throughout the SRPA near CFA/INTEC.

**4.3.1.2.12 Plutonium-238**—The MCL for plutonium-238 is 7.02 pCi/L. The background level in the SRPA have not been established. The risk based concentration is 0.161 pCi/L ( $10^{-6}$  risk).

Sixteen wells in the vicinity of CFA have been sampled for plutonium-238 at least once. Data indicate that four of the 16 wells have plutonium-238 above the detection limit. The only well located at CFA is CFA-1 and the only well that has had two detections of plutonium-238. The other three wells; M7S, located near RWMC, USGS 37 and 112, located between INTEC and CFA, have had one positive detection each.

Monitoring wells at CFA are not regularly sampled for plutonium-238. Wells USGS 37 and 77 are the only two wells that are regularly sampled for plutonium-238. Both of these wells are located upgradient from CFA.

Trend analysis for plutonium-238 indicate that well CFA-1 had two positive detections in 1987 and two nondetects in 1988 (Burgess, 1998). This well has not been analyzed for plutonium-238 since the samples collected in 1988. Well M7S had one positive detection in 1993 and three nondetects in 1996 and 1997. Well USGS 37 has had 12 nondetects since 1982 prior to the positive detection in 1995.

Well USGS 112 has had a sampled result above the risk-based concentration for plutonium-238. This sample was collected in October 1994 and the well has since had one sample collected in May 1995 which was a nondetect. None of the 41 wells in the vicinity of CFA have had sample results with concentrations above the MCL.

Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that total plutonium in the SRPA, originating from INTEC, will substantially affect groundwater concentrations at CFA in the future. The model prediction simulated from 1972 through the year 3804. The predicted maximum aquifer concentration at the end of the simulation time is 35.1 pCi/L which exceeds the  $10^{-6}$  risk concentration but not the MCL (62 pCi/L for total plutonium). Schafer et al., (1996) predictions indicate that the aquifer area with predicted maximum concentrations greater than the  $10^{-6}$  risk concentration is very large by the year 2095. At this time in the simulation, the plutonium concentration affecting the CFA area is at the  $10^{-7}$  risk level. The  $10^{-6}$  risk concentration will affect the area at CFA between the years 2227 and 2775. Concentrations in the aquifer continue increasing to above the  $10^{-5}$  risk concentration between the years 2775 and 3322.

Schafer et al., (1996) state that the concentration of plutonium in the vadose zone at INTEC will never drop below the  $10^{-6}$  risk concentration or fall below the MCL in the time period simulated (through the year 3800). By the year 2095, only 2% of the mass had left the vadose zone, and although still above the  $10^{-6}$  risk level in 3815, the simulations were terminated with only 38% of the mass having left the vadose zone.

Schafer et al., (1996) state that their model predictions did not include plutonium-238 within the total plutonium because it was assumed that it was not present in the source inventory. They suggest that



the absence of plutonium-238 in the source inventory was a data gap. Plutonium-238 was reported in some contaminated soil but not in the major INTEC sources.

**4.3.1.2.13 Plutonium-239**—The MCL for plutonium-239 is 62.1 pCi/L. The background concentration in the SRPA is not established. The  $10^{-6}$  risk based concentration is 0.151 pCi/L.

One well located in the vicinity of CFA has been sampled for plutonium-239. Three samples from well M7S located downgradient of CFA were analyzed for plutonium-239 from June 1996 through April 1997 and all have been below the detection limit. Wells located between INTEC and CFA have not been analyzed for plutonium-239. Therefore, it is not known; if the SRPA beneath CFA contains plutonium-239 and the potential source(s) of this contaminant.

Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that total plutonium in the SRPA, originating from INTEC, will substantially affect groundwater concentrations at CFA in the future. The bulk of their activity used to calculate the total plutonium was plutonium-239. The following was used as the total plutonium activity distribution in their model; 60.3% plutonium-239, 30.0% plutonium-240, 9.6% plutonium-241, and 0.04% plutonium-242. These model simulations predict that total plutonium concentrations at CFA will not significantly be affected until approximately 2095. At this time total plutonium levels will exceed the  $10^{-7}$  risk levels. See Section 4.3.1.2.12 for additional information on plutonium model simulations in the SRPA.

**4.3.1.2.14 Plutonium-239/240**—The MCL for plutonium-239/240 is 62.1 pCi/L. The background concentration in the SRPA has not been established. The  $10^{-6}$  risk concentration is 0.151 pCi/L.

Sixteen wells in the vicinity of CFA have been sampled for plutonium-239/240 at least once. Two of the 16 wells have indicated the presence of plutonium-239/240 above the detection limit. These wells include M7S, located near RWMC and USGS 112, located between INTEC and CFA, have had one positive detection each. The plutonium-239/240 levels were not above the MCL, however the risk-based concentration was exceeded.

Monitoring well at CFA are not regularly monitored for plutonium-239/240. Wells USGS 34, 37 and 38 are the only three wells out of the 41 which are regularly sampled for plutonium-239/240. All of these wells are located between INTEC and CFA.

Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that total plutonium in the SRPA, originating from INTEC, will substantially affect groundwater concentrations at CFA in the future. The following was used as the total plutonium activity distribution in their model; 60.3% plutonium-239, 30.0% plutonium-240, 9.6% plutonium-241, and 0.04% plutonium-242. These model simulations predict that total plutonium concentrations at CFA will not significantly be affected until approximately 2095. At this time total plutonium levels will exceed the  $10^{-7}$  risk levels. See Section 4.3.1.2.12 for additional information on plutonium model simulations in the SRPA.

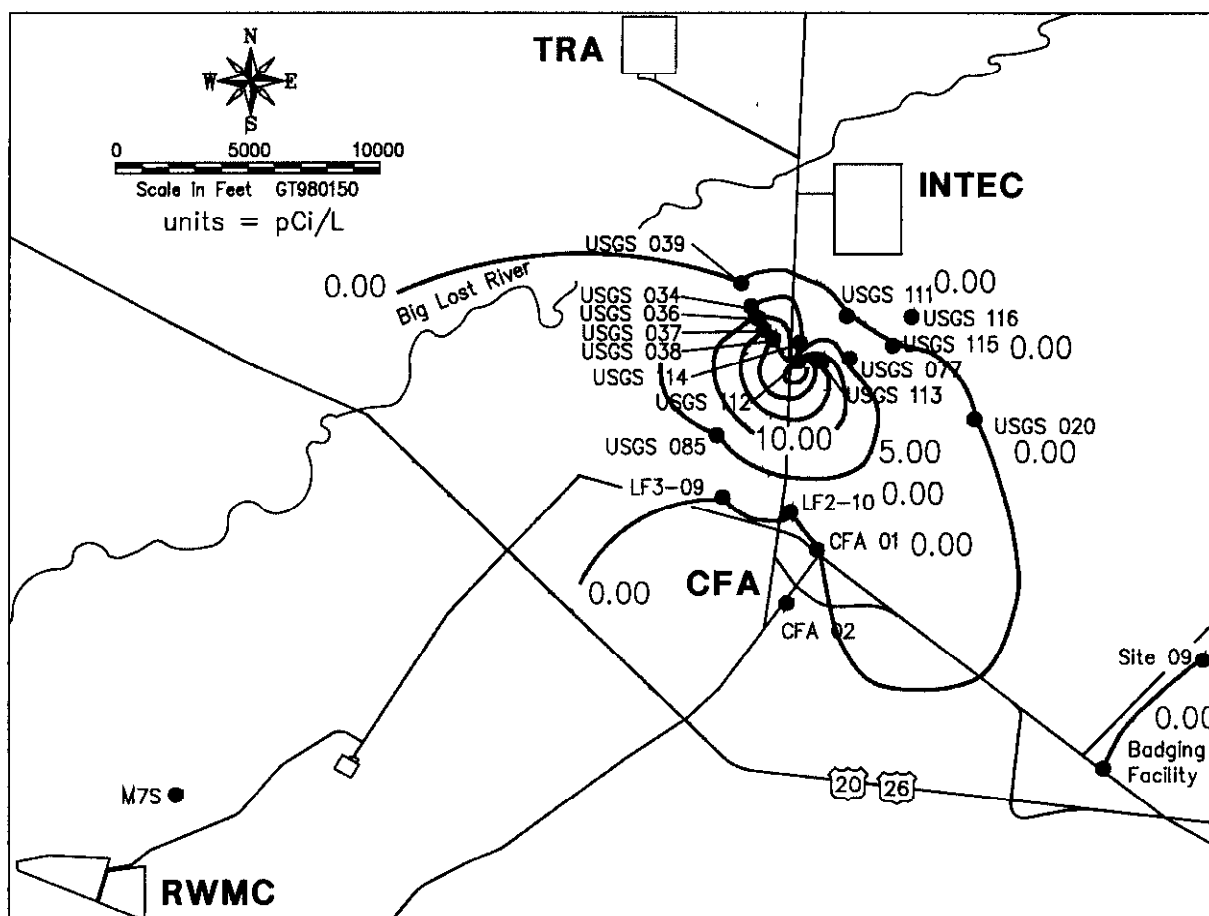
**4.3.1.2.15 Strontium-90**—The MCL for strontium-90 is 8 pCi/L and the background level in the SRPA is 0.05 pCi/L (Orr et al., 1991). The  $10^{-6}$  risk based concentration is 0.852 pCi/L.

Thirty-five of the 41 wells in the vicinity of CFA have been sampled at least once for strontium-90. Data indicate that twenty of the 35 have detected strontium-90. Six of the 20 wells are located at CFA, M7S is located near RWMC, and the remaining 13 wells are located between INTEC and CFA.

Four wells including; CFA-1, CFA-2, LF2-10, and LF3-09 are regularly monitored for strontium-90 at CFA. Fifteen wells, located between INTEC and CFA, are regularly monitored for strontium-90.

Strontium-90 trend analysis indicate that wells M7S, located near RWMC, USGS 35, 36, 37, 38, and 116, all located between INTEC and CFA have increasing concentrations throughout their sampling history (Burgess, 1998). However, only two of these wells indicate increasing concentration trends since 1990. Those wells having increasing concentrations since 1990 include M7S, USGS 34, 85, and 116. Most of the wells immediately downgradient from INTEC that have been regularly monitored for strontium-90 since the early 1960s have peaked in concentration ranging from the late 1960s to mid 1980s.

Groundwater contour concentration diagrams for 1996 strontium-90 concentrations indicate the highest Sr-90 concentrations occur in wells located immediately downgradient from INTEC (Figure 4-35). The lack of strontium-90 in wells located at CFA indicates the lack of source(s) contributing this contaminant to the aquifer at the present time. Also, groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that strontium-90 concentrations originating from INTEC would not significantly affect wells at CFA until approximately 2025.



**Figure 4-35.** 1996 strontium-90 concentrations in the Snake River Plain aquifer near CFA. Concentrations in pCi/L.

Schafer et al., (1996) suggest that model simulations for strontium-90 concentrations indicate that the overall highest concentration at INTEC was predicted to have been 920 pCi/L in 1967. However, their model predictions indicate that strontium-90 concentrations near the  $10^{-7}$  risk level will not occur until approximately 2025. The  $10^{-7}$  risk concentrations will remain in the aquifer at CFA until between 2172 and 2227. The  $10^{-6}$  risk concentrations will closely approach the CFA area in 2095.

Schafer et al., (1996) state that if Kds used in the model are correct, the field measurements of strontium-90 taken in this decade should be a reflection of the mass disposed to the injection well, and not the arrival of strontium-90 from the vadose zone. However, strontium-90 moves slowly with a Kd of  $24 \text{ km}^3/\text{g}$  but it decays rapidly with a half life of 29.1 years. As a result, much of the strontium-90 source decays while still resident in the vadose zone. Strontium-90 releases to the aquifer from the vadose zone occurs from 1990 through 2300, peaking in 2058, and tailing slowly off after the percolation ponds are removed in 2095. Model predictions also show that the peak concentration reaches a value of 348 pCi/L in 2227, but never falls below the  $10^{-6}$  risk concentration in the vadose zone. Although still above the  $10^{-6}$  risk level in 2227, the simulations were terminated because 95.8% of the initial mass in place had either entered the aquifer or decayed and because the concentrations entering the aquifer were less than risk based limits.

Modeling efforts, groundwater data, and trend analysis all indicate the significant source of strontium-90 located at INTEC. It is possible that sites at CFA contribute strontium-90 to the aquifer, however these concentrations are minimal compared to those originating from upgradient sources.

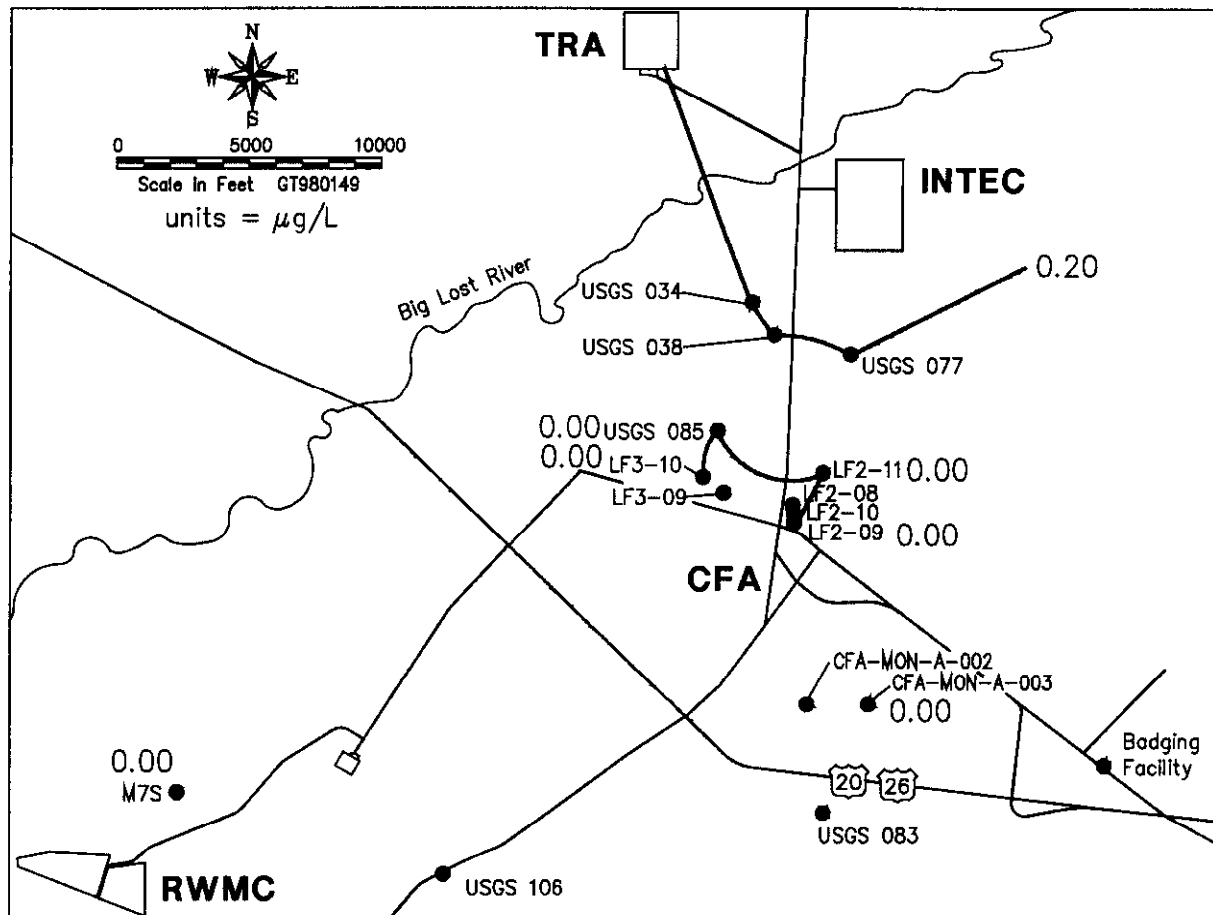
**4.3.1.2.16 Trichloroethene**—Trichloroethene commonly is used as a dry-cleaning fluid, an extraction solvent for oils, a refrigerant and heat exchange liquid, a diluent in paints and adhesives and to degrease and dry metals and electric parts. The MCL for trichloroethene is 5 ug/L and the risk based concentration is 7.74 ug/L ( $10^{-6}$  risk). Trichloroethene is not naturally occurring; therefore, the true background in the SRPA should be zero.

Forty of the 41 wells in the vicinity of CFA have been sampled for trichloroethene at least once. Data indicate that trichloroethene was detected on eight of the 40 wells. Wells; USGS 34, 38, and 77 are located upgradient from CFA. Four wells in which trichloroethene was detected are located within CFA, CFA-1, CFA-2, LF2-08, and LF2-09. The remaining well which has detected trichloroethene was detected in, located downgradient of CFA, near the RWMC.

A total of eight wells are routinely sampled at CFA for trichloroethene. However, only two of these routinely monitored wells (LF2-08 and LF2-09) have detected trichloroethene. Wells CFA-1 and CFA-2 were sampled three times between 1987 and 1993 and detected trichloroethene was detected in all samples. These wells have been sampled since. Trend analysis indicate that trichloroethene concentrations in well LF2-08 and LF2-09 have decreased to below the detection limit since July 1996 and October 1996, respectively (Burgess, 1998).

A total of four wells are routinely sampled for trichloroethene upgradient of CFA. All but one of these have trichloroethene above the detection limit. However, all concentrations from these three wells, USGS 34, 38, and 77 were at the detection limit of 0.2 ug/L. Trend analysis for all three wells indicate concentrations remained below the detection limit until the October 1995 sampling event.

Present groundwater concentrations indicate, as stated above, that trichloroethene presently exists in wells upgradient from CFA (Figure 4-36). Therefore, based on these groundwater data and trend analysis, source(s) for trichloroethene could be located at CFA, upgradient of CFA, or both. However, based on the overall higher concentrations detected in wells at CFA verses concentrations in upgradient wells, this would strongly suggest a CFA source(s). If the source(s) were upgradient of CFA, the



**Figure 4-36.** 1996 trichloroethene concentrations in the SRPA near CFA (concentrations in ug/L).

expected concentrations would be higher near the source and decrease, due to dilution, downgradient. Organic compounds historically have been used at facilities upgradient of CFA for activities in conjunction with the operation of nuclear reactors and the processing of nuclear fuel (Mann and Knobel 1987). Groundwater data indicate that the aquifer contains detectable concentrations of organic compounds in concentrations consistent with the range of trichloroethene stated above. The possibility that Landfill II is a source of trichloroethene is unlikely due to the decreasing trends in the data, known upgradient sources, and widespread detections in the aquifer.

**4.3.1.2.17 Tritium**—Since the 1950s, the groundwater at the INEEL has contained a tritium plume from the disposal of liquid waste. The primary sources of this tritium in the SRPA have been the injection of wastewater through the disposal well at INTEC and the discharge of wastewater to the infiltration ponds at INTEC and TRA. The disposal well was active from 1952 to 1984, after which time most radioactive wastewater was rerouted for discharge to the INTEC infiltration pond. The total tritium activity disposed during the history of the injection well and ponds was approximately 20,000 Ci.

The MCL for tritium is 20,000 pCi/L and the risk based ( $10^{-6}$ ) concentration is 666 pCi/L. The background concentration for the SRPA is 0.15 pCi/L (Orr et al., 1991).

Forty wells in the vicinity of CFA have been sampled for tritium at least once. The only well which has never been sampled for tritium is CFA-MON-A-003, located immediately downgradient of

CFA. Four wells at CFA are routinely monitored for tritium, CFA-1, CFA-2, LF2-10, LF3-09, and LF3-11 (annually). All 21 of the wells located between INTEC and CFA are routinely sampled for tritium.

Of the 41 wells, only four have never detected tritium above the detection limit including; CFA-MON-A-001, STF-MON-A-01A, STF-MON-A-02A, and the badging facility well.

Twenty-three of the 37 wells which have tritium have had concentrations above the MCL. All 37 of these wells have had concentrations above the background level and the risk based concentration. The latest tritium concentration data as compared to MCLs, background, and risk based concentration is illustrated in Table 4-3. This table lists wells in which the latest sample concentration exceeds one or all of the following; MCL, background, and risk based concentration for tritium in the groundwater.

Trend analysis for tritium concentrations for most wells in the vicinity of CFA indicate an overall decrease throughout their sampling history (Burgess, 1998). However, wells USGS 35 and 104 indicate an overall increasing concentration. Concentration trends in most wells since 1993 are relatively flat or slightly decreased. However, some wells do indicate a slight increase in concentration trends since 1993 including; CFA-1, LF2-08, LF3-08, M7S, USGS 35, 39, and 104. 1996 tritium concentration diagrams illustrate the highest concentrations are located in wells immediately downgradient of INTEC (Figure 4-37). However, two distinct tritium plumes occur; one located near wells immediately south of INTEC and the other located near wells at CFA. This figure was generated using a kriging package. The reason the software illustrates two distinct plumes is because of the lack of wells between these well groups. If wells were located between these groups there would most likely be one continuous tritium plume, originating at INTEC and moving downgradient through the CFA area.

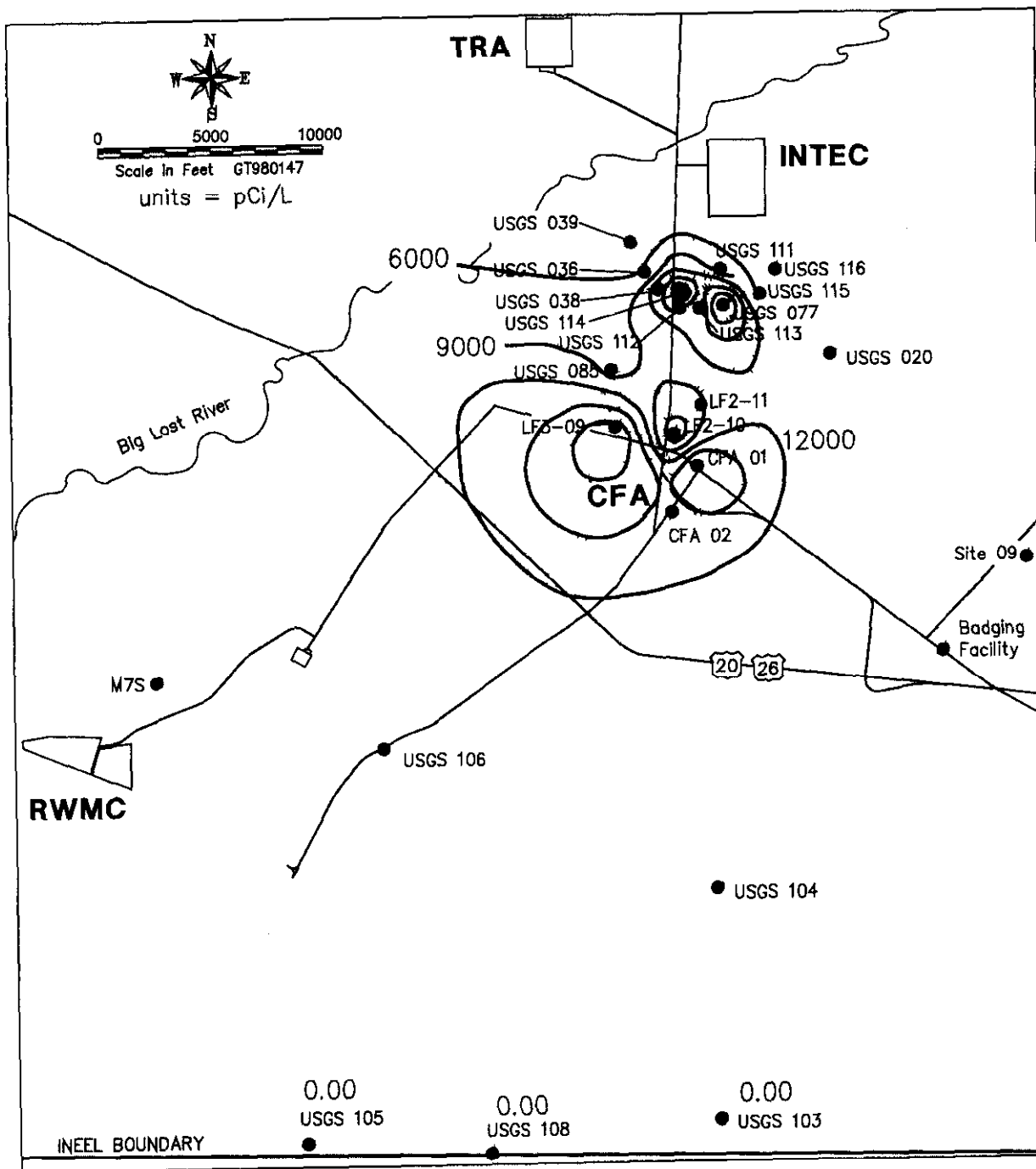
Groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that tritium, originating from INTEC significantly affects the CFA area. Their model simulations began in 1959 and continued through 2095. According to their modeling predictions tritium concentrations above the MCL and background levels will be present at CFA between 1992 and 2025. Risk based concentrations ( $10^{-6}$ ) will exist in the CFA area between 2025 and 2063. Schafer et al., (1996) suggested the peak concentration in the aquifer at INTEC was  $2.6 \times 10^6$  pCi/L in 1960. Comparisons of model predicted concentrations to aquifer field data are very close to measured values in most wells. This is to be expected given the excellent vadose zone matches and the fact that their aquifer model was calibrated to the tritium field data.

Modeling efforts, groundwater data, and trend analysis all indicate the significant source of tritium being located at INTEC/TRA. It is possible that sites at CFA contribute tritium to the aquifer, however these concentrations are minimal compared to those originating from upgradient sources. The only possible site from which tritium would have been discharged at CFA would be the STP Drainfield, which discharged treated effluent from the plant to the subsurface. Tritium-contaminated water, which was pumped from the aquifer at the CFA production wells, was discharged to the drainfield after treatment at the STP. There are no known process at CFA that would have generated additional tritium.

**4.3.1.2.18 Uranium-234.** The MCL is for uranium-234 is 13.9 pCi/L. The background level in the SRPA has not been established. The risk based concentration ( $10^{-6}$ ) is 1.07 pCi/L.

**Table 4-3. Tritium data for wells in the vicinity of CFA.**

Well	Last Sample	Concentration of Last Sample (pCi/L)	Does Sample Exceed Background Level? (150 pCi/L)	Does Sample Exceed MCL? (20,000 pCi/L)	Does Sample Exceed $10^{-6}$ Risk Based Level? (666 pCi/L)
CFA-1	7/96	18,800	YES	NO	YES
CFA-2	7/96	14,100	YES	NO	YES
CFA-MON-002	7/95	1,970	YES	NO	YES
EOCR	10/74	1,000	YES	NO	YES
LF2-08	5/95	21,000	YES	YES	YES
LF2-09	10/93	25,000	YES	YES	YES
LF2-10	4/96	2,900	YES	NO	YES
LF2-11	8/95	24,000	YES	YES	YES
LF3-08	5/95	25,200	YES	YES	YES
LF3-09	7/96	22,300	YES	YES	YES
LF3-10	8/95	17,600	YES	NO	YES
LF3-11	10/93	16,000	YES	NO	YES
M7S	4/97	1,430	YES	NO	YES
"MORE"	4/95	1,300	YES	NO	YES
SITE-09	7/96	200	YES	NO	YES
USGS 20	4/96	7,400	YES	NO	YES
USGS 34	4/96	3,800	YES	NO	YES
USGS 35	4/96	6,100	YES	NO	YES
USGS 36	7/96	5,200	YES	NO	YES
USGS 37	4/96	12,000	YES	NO	YES
USGS 38	4/96	14,200	YES	NO	YES
USGS 39	7/96	4,800	YES	NO	YES
USGS 77	4/96	25,100	YES	YES	YES
USGS 85	4/96	7,900	YES	NO	YES
USGS 104	10/96	1,760	YES	NO	YES
USGS 106	10/96	1,400	YES	NO	YES
USGS 111	4/96	7,500	YES	NO	YES
USGS 112	7/96	13,400	YES	NO	YES
USGS 113	7/96	10,800	YES	NO	YES
USGS 114	7/96	22,400	YES	YES	YES
USGS 115	7/96	4,800	YES	NO	YES
USGS 116	7/96	3,800	YES	NO	YES



**Figure 4-37.** Tritium concentrations in the SRPA near CFA. (concentrations in pCi/L)

Five wells out of the 41 in the vicinity of CFA have been sampled for uranium-234. All of five wells including USGS 36, 39, 112, 114, and 116 have detected uranium-234 above the detection limit. These wells were sampled only once in October 1994 with the exception of well USGS 112 which was sampled again in May 1995, and resulted in an additional positive detection. The MCL has never been exceeded in these wells however, the risk based concentration was exceeded in all samples collected from USGS 39 and 112. There are no wells sampled for uranium-234 at CFA.

Due to the fact that little groundwater data has been collected for uranium-234 in either the INTEC or CFA areas, it is difficult to determine the source area(s). However, groundwater model predictions from the WAG 3 RI/FS (Schafer et al., 1996) indicate that total uranium, originating from INTEC, will significantly affect groundwater concentrations at CFA. These model simulations indicate that groundwater concentrations at CFA will exceed 0.14 pCi/L from approximately 1994 through the end of their simulations which ended in 2939. Concentrations exceeding 1.4 pCi/L would occur at CFA between 1994 and 2095. Concentrations exceeding the  $10^{-6}$  risk levels were predicted to occur at CFA between 1994 and 2025 and continuing through the end of the simulation period at 2939.

Schafer et al., (1996) state that total uranium to the aquifer from the vadose zone peaks in 2435, with only 1% of the mass leaving the vadose zone by 2095, and only 53.5% by 2939 when the simulation was stopped. Throughout the total simulation time in the aquifer, there are two local maxima in the peak concentration at INTEC which are both below the MCL and above the  $10^{-6}$  risk levels. These occur early in 1986 and later in 2475. Data used for model simulations included various uranium isotopes in the soils inventory (82.24%) and were discharged to the injection well (14.24%) and percolation ponds (3.11%), as well as being a part of the CPP-31 (0.39%) and CPP-28 (0.02%) releases. A single simulation for the total uranium was performed. Resultant concentrations and risk were calculated assuming that the total uranium mass distribution is  $6 \times 10^{-3}\%$  uranium-234, 0.6% uranium-235,  $1.5 \times 10^{-2}\%$  uranium-236, and 99.38% uranium-238. These distributions correspond with the activity distribution of 51.2% uranium-234, 1.8% uranium-235, 1.3% uranium-236, and 45.7% uranium-238.

Due to the lack of groundwater field data it is impossible to determine all sources for all uranium isotopes. It is possible that CFA is contributing to uranium groundwater concentrations based on detections of uranium in the vadose zone. However, these concentrations, originating from CFA would most likely be minimal compared to those originating from upgradient sources.

**4.3.1.2.19 Uranium-235.** The MCL for uranium-235 is 14.5 pCi/L. The background concentration has not been established in the SRPA. The  $10^{-6}$  risk based concentration is 1.01 pCi/L.

Six wells out of the 41 wells in the vicinity of CFA have been sampled for uranium-235. All of these wells are located between INTEC and CFA, except for M7S which is located near the RWMC. Most of the wells have been sampled only once and no well has uranium-235 above the detection limit.

Uranium-235 has been detected in the vadose zone (soil samples) at CFA and therefore may be contributing this contaminant to the SRPA. However, without analytical data it is impossible to determine if there is a source or where that source(s) is located. However, modeling efforts by Schafer et al., (1996) indicate that uranium, originating from INTEC, will significantly influence groundwater concentrations at CFA in the near future. For additional information on these model predictions see Section 4.3.1.2.18.

**4.3.1.2.20 Uranium-238.** The MCL for uranium-238 is 14.6 pCi/L. The background concentration has not been established in the SRPA. The  $10^{-6}$  risk-based concentration is 0.768 pCi/L.



Five wells in the vicinity of CFA have been monitored for uranium-238. All of these wells are located between INTEC and CFA including USGS 36, 112, 114, and 116, except well M7S which is located near the RWMC. Most of the wells have been sampled only once and all have uranium-238 above the detection limit. The single samples from these wells were collected in October 1994 and an additional sample was collected from USGS 112 in 1995 uranium-238 was not detected. Samples from these wells did not exceed the MCL, however the sample collected from USGS 112 (0.9 pCi/L) in October 1994 did exceed the risk based concentration. No groundwater wells at CFA are monitored for uranium-238.

Uranium-238 has been detected in the vadose zone (soil samples) at CFA and therefore may be contributing this contaminant to the SRPA. However, without monitor well data it is impossible to determine if there is a source or where that source(s) is located. The limited upgradient groundwater data along with model simulations by Schafer et al., (1996), indicate a source at INTEC. These modeling efforts suggest that uranium, originating from INTEC, will significantly influence groundwater concentrations at CFA in the near future. For additional information on these model predictions see Section 4.3.1.2.18.

**4.3.1.2.21 Zinc.** The background concentration is 14.5 ug/L in the SRPA. The risk-based concentration for zinc is 10,000 ug/L (HI=1 risk).

Thirty wells in the vicinity of CFA have been sampled for zinc. All of these wells except USGS 36 have zinc above the detection limit. Twelve of the 30 wells are located at CFA and are regularly monitored for zinc. Most of the remaining 18 wells are located upgradient of CFA and are not regularly monitored for zinc. Most of these wells, located between INTEC and CFA, have been sampled for zinc once or twice.

One well, LF-3-11, has had a single sample with a concentration greater than the MCL and the HI=1 risk level. This sample was collected in August 1993 and contained 35,500 ug/L of zinc. However, a single sample collected in June 1993 contained only 375 ug/L and a sample during October 1993 contained 1,050 ug/L. Therefore, based on the other concentrations the 35,500 ug/L concentration to be considered suspect.

High concentrations of zinc may be the result of galvanized pipe in the monitoring wells. Zinc from the galvanized pipe is added to the groundwater, discharging through the pump, by "electro-plating." This is evident in the USGS wells located between INTEC and CFA. These wells are relatively close together and should provide similar zinc concentrations. However, those wells which contain stainless steel material below the water table including; USGS 20, 34, 35, 37, 38, 39, and 85, have significantly lower zinc concentrations than wells with galvanized material below the water table. Those wells in proximity to the above listed wells which have galvanized material include; USGS 111, 112, 113, 114, 115, and 116. The average zinc concentration from those wells which have all stainless steel material below the water table is 54 ug/L. The average concentration for wells having galvanized material below the water table is 223 ug/L. These averages included all samples from the above stated wells. The same comparison, between galvanized versus stainless steel material, could not be performed for wells at CFA due to the lack of well completion information.

Regardless of the above stated reasons for the suspect levels of zinc at CFA, the concentrations appear to be overall higher than those from upgradient wells. This is illustrated in Figure 4-38, which is the most current zinc groundwater concentrations from the wells in the vicinity of CFA. This figure is compiled using 1995 through 1997 data. The USGS wells, predominately located between INTEC and CFA, were last sampled in 1995 and the wells near CFA were sampled in 1997. The wells at CFA were not sampled for zinc until 1996.

There are no known discharges of zinc to the soil or groundwater. Detections of zinc are due to galvanized components in monitoring wells.

#### **4.3.2 Conclusion**

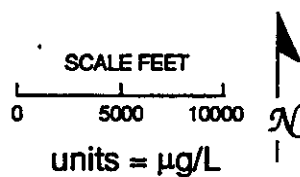
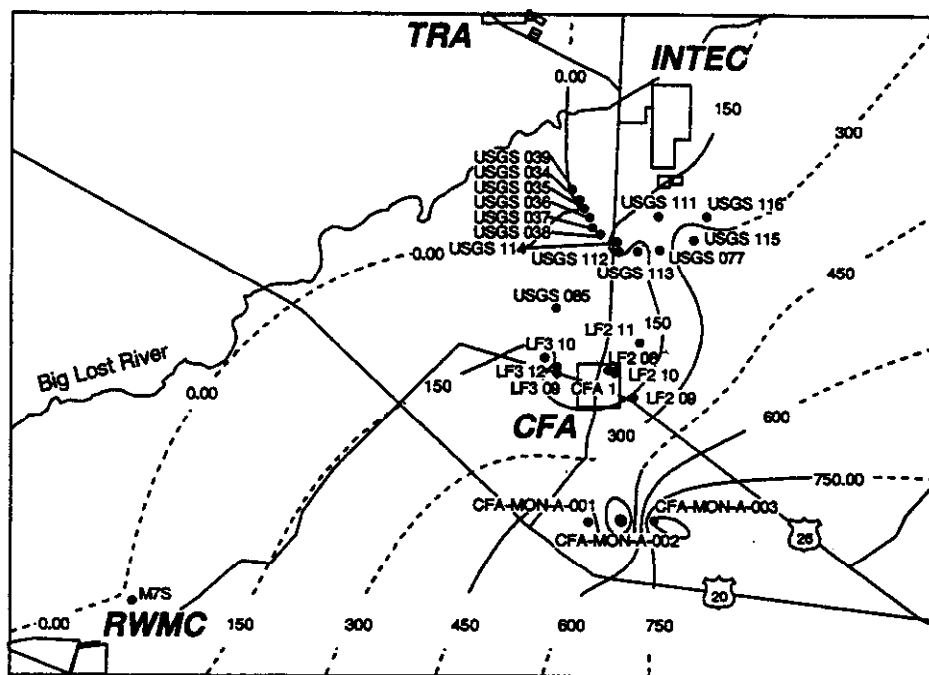
Analysis of groundwater data from CFA wells indicated that five of the 26 COCs identified for CFA have never been sampled for in the groundwater and less than half of the remaining 21 have had adequate monitoring in order to determine a source(s) location. Several COCs were sampled once or several times in the past with all samples indicating a positive detection and have not been sampled since. In general, the well spacing at CFA and between CFA and INTEC is adequate, however the inconsistent monitoring of COCs makes it difficult if not impossible to identify specific source(s) of contamination at CFA. Groundwater data for each COC is summarized in Table 4-4. Groundwater modeling results that were developed to support the baseline risk assessment are discussed in Section 6.3.3.3.

Groundwater data collected from groundwater monitoring in the vicinity of CFA, INTEC, TRA, and RWMC were evaluated. Several conclusions can be made related to the potential contaminants and the groundwater monitoring wells in the vicinity of CFA, as a result of this evaluation.

The 25 COCs evaluated are summarized in Table 4-4 and include VOC, inorganic, and radiological chemicals that have been detected in groundwater monitoring wells. The presence of these contaminants in the groundwater are primarily attributable to INTEC and TRA, facilities upgradient from CFA.

The groundwater monitoring wells from which data was collected was also evaluated and resulted in the following general conclusions related to the groundwater monitoring wells.

1. The groundwater-monitoring network for CFA as a facility is inadequate, primarily due to lack of downgradient wells. The three existing downgradient wells (CFA-MON-01, -02, and -03) are likely too far downgradient of the source (approximately 1 mile) to determine the source of contaminants if detected.
2. The monitoring network around CFA Landfills 1 and 3 is adequate. The existing monitoring program and the placement of wells at the CFA Landfills is designed to detect potential contaminants associated with the landfills. However, concerns over whether an additional downgradient well is still needed for Landfill 1 were expressed during the scoping of OU 4-13. The monitoring network around Landfill 2 is adequate.
3. In general, the number of upgradient wells and their placement is adequate, however inconsistent monitoring of COCs makes identification of contaminant sources difficult. Samples for the COCs identified have not been collected from 5 of the 26 wells in the vicinity of CFA. Also, monitoring of the remaining 21 wells is inadequate to determine the source(s) of contaminants in the groundwater.
4. GWSCREEN modeling of potential contaminants at CFA release sites and former tank sites indicates that potential petroleum releases will not pose unacceptable risk to groundwater receptors. It is not possible to verify the model outputs because of the lack of groundwater data collected from downgradient.



**Figure 4-38.** 1995–1997 zinc concentrations in the SRPA near CFA. (Concentrations in  $\mu\text{g/L}$ .)

**Table 4-4.** Summary of groundwater contaminants of concern.

Contaminants of Concern	Monitoring Practice	Result of Monitoring	Possible Sources CFA	Possible Sources INTEC/TRA	Comments
1-2, Dichloroethane	Inconsistent	Limited samples suggest the COC is not present at either facility	Unknown	Unknown	
Americium-241	No samples from CFA wells. Inconsistent monitoring in wells between INTEC and CFA.	Predominately non-detects, however, some positive detects in wells between INTEC and CFA.	Unknown	Yes	Model predictions indicate Am-241 originating at INTEC should not significantly effect groundwater concentrations at CFA.
Arsenic	Good	CFA wells indicate increasing concentrations since 1996. Widely distributed throughout the regional area.	Unknown – the latest concentrations are higher at CFA than in upgradient wells. However, this could be due to INTEC plume movement downgradient to CFA area.	Yes	Model predictions indicate arsenic from INTEC will significantly affect concentrations at CFA.
Beryllium	Inconsistent	Not consistently detected above background levels	Unknown	Unknown	
Cadmium	Good at CFA wells. Inconsistent in upgradient wells.	Widely distributed in both soil and groundwater throughout regional area.	Probable – Concentrations at CFA are higher than in upgradient wells	Unknown	It is unlikely that a cadmium source exists at CFA due to widespread distribution I the soil and groundwater regionally.
Chloromethane	Good at CFA wells. Moderate to poor in upgradient wells.	Does not appear to be present in the area near CFA.	No	Probably not, unless it is a recent release.	
Chromium	Good	Widely distributed in wells near INTEC and CFA.	Unknown – high concentrations from upgradient sources	Yes	

**Table 4-4.** (continued).

Contaminants of Concern	Monitoring Practice	Result of Monitoring	Possible Sources CFA	Possible Sources INTEC/TRA	Comments
			overshadow any contributions from a local source.		
Cesium-137	Inconsistent at CFA. Recent monitoring in upgradient wells is good.	Not present in any of the monitored wells near CFA or INTEC.	Unknown – limited data suggests it is not present.	No	Only one well sampled near CFA since 1995.
Iodine-129	Poor	Concentrations from 1986 to 1995 indicate high concentrations originating near INTEC and through time this plume has moved downgradient to CFA.	Unknown – upgradient concentrations are overshadowing any local contributions to the aquifer.	Yes	
Mercury	Good at CFA. Inconsistent in upgradient wells.	Inconsistent detections at levels slightly higher than background in most CFA and INTEC wells.	Possible – overall, concentrations in CFA wells are higher than in upgradient wells.	Unknown, the few positive concentrations are slightly above background levels.	No consistent positive concentrations from wells near CFA and INTEC.
Phenol	Not monitored in wells near CFA. One round of samples from upgradient wells.	One round (6 wells) of samples from upgradient wells did not have a positive detect.	Unknown	Unknown	
Plutonium-238	Poor at CFA wells. Inconsistent at upgradient wells.	Sparse data suggests it is not a significant problem in the aquifer at CFA or upgradient near INTEC.	Unknown	Unknown	
Plutonium-239	No wells are sampled at CFA nor at INTEC.		Unknown	Unknown	

**Table 4-4.** (continued).

Contaminants of Concern	Monitoring Practice	Result of Monitoring	Possible Sources CFA	Possible Sources INTEC/TRA	Comments
Plutonium-239/240	No wells at CFA are monitored. Inconsistent monitoring in upgradient wells.	Sparse sampling data from upgradient wells suggests it not present.	Unknown	Unknown	Model predictions suggest INTEC sources will significantly affect CFA in the future.
Strontium-90	Inconsistent at CFA wells. Good in upgradient wells.	Few positive detections at CFA. Upgradient wells have higher concentrations.	Unknown – Due to inconsistent monitoring and/or overshadowing of upgradient concentrations.	Yes	Models suggest that concentrations at CFA will not be significantly affected from upgradient sources until approximately 2025.
Tritium	Good	Higher concentrations in upgradient wells.	Unknown – high concentrations from upgradient sources would most likely overshadow all local sources.	Yes	
Trichloroethene	Good in CFA wells. Inconsistent in upgradient wells.	Overall, higher concentrations from CFA wells.	Yes	Probable – Several positive detections at the detection level.	
Uranium-234 and 238	Poor	Five wells (1 samples each) had positive detection	Unknown	Probable – all samples have positive detections	
Uranium-235	Poor	Five wells (1 sample each, all nondetects)	Unknown	Unknown – limited samples did not detect U-235.	
Zinc	Good	Widely distributed in the CFA-INTEC area	Yes	Yes	Detections of zinc are due to galvanized components on the monitoring wells.
Aroclor-1254	No Data				

**Table 4-4.** (continued).

Contaminants of Concern	Monitoring Practice	Result of Monitoring	Possible Sources CFA	Possible Sources INTEC/TRA	Comments
Aroclor-1260	No Data				
Benzaldehyde	No Data				
TPH-gasoline	No Data				
TPH-diesel	No Data				

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